THE
COLORADO SCHOOL OF MINES
MAGAZINE

APR 20 192
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MARCH - 1926
VOL. 15 - No. 11

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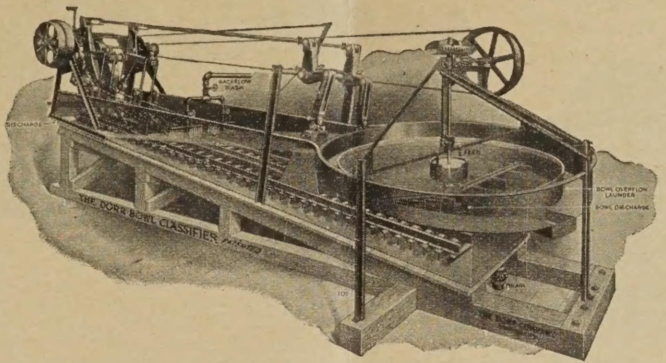

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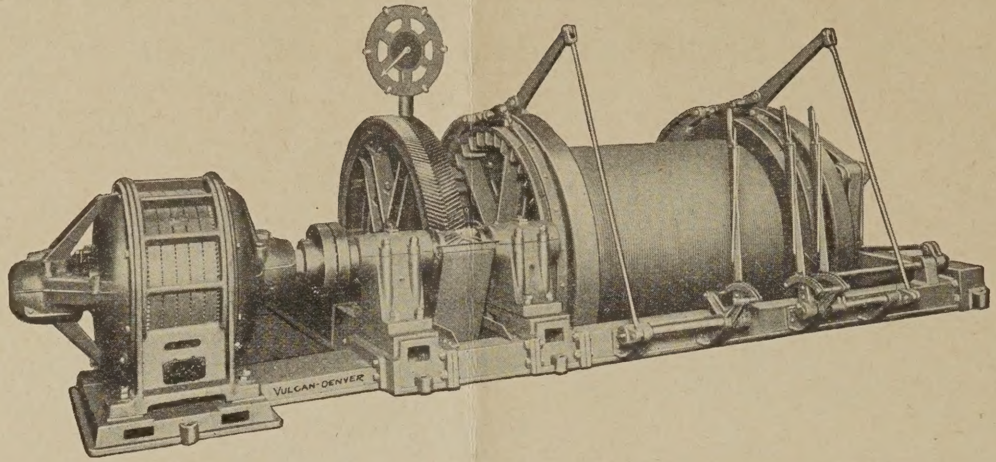

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M. R. (Monty) Budd, '24, *Editor*

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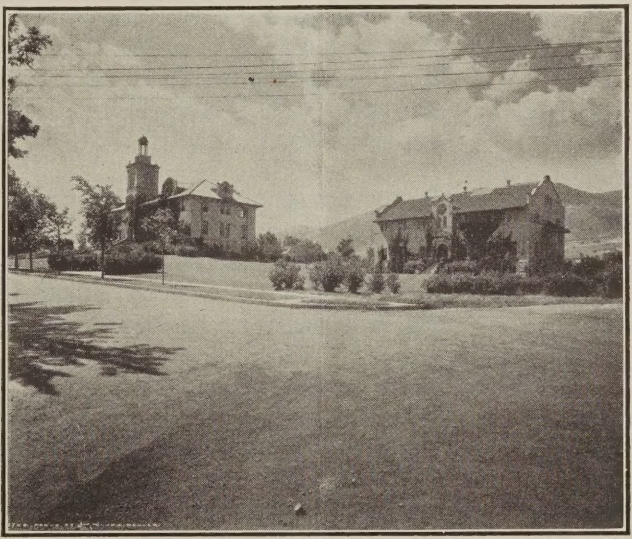

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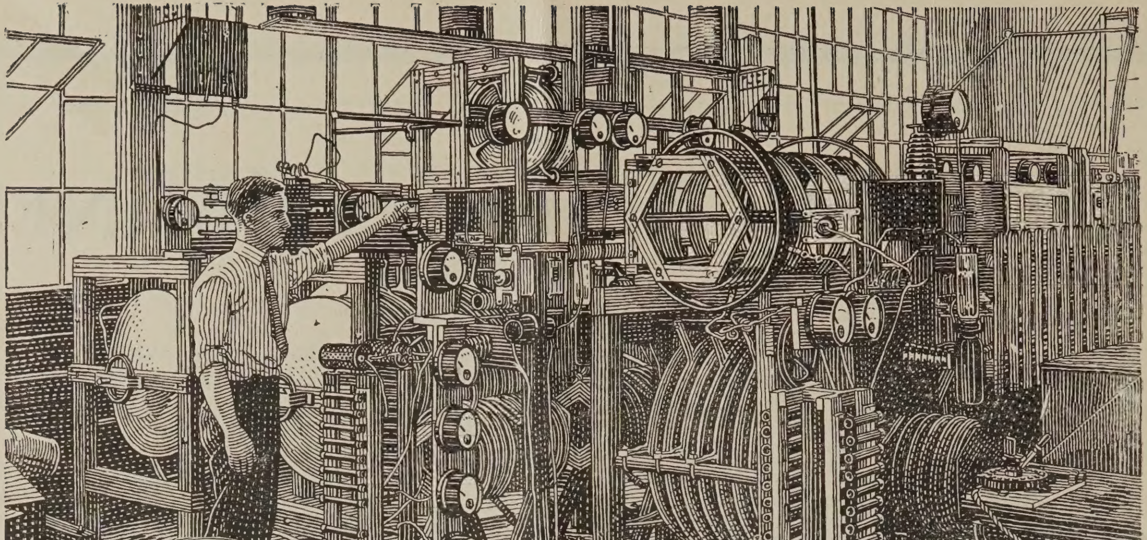

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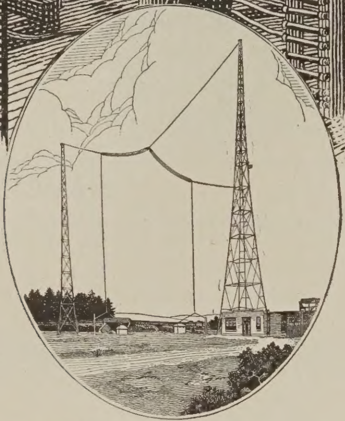

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VOLUME XV. MARCH, 1926 NUMBER 11

The Mineral Zones
of the White Cross District and Neighboring Deposits in Hinsdale County, Colorado

By W. Horatio Brown, '23*

INTRODUCTION AND SUMMARY

This paper is a study of the ores of Hinsdale county, Colorado, and their relations to each other and to their geological environment. The ores of the western part of the county, near Whitecross, afford an instructive example of the standard mineral zones such as have been described elsewhere. The geology of this area, together with the paragenesis of the ores, is described in the greater detail.

It was noted that the order of deposition of the minerals varied in the different zones and that this variation appeared to be related to the quantity of the minerals present in the ores. This is taken as an indication that the relative concentration of the metals in the magmatic waters is important in determining the order of deposition of the minerals. As deposition depends on solubility as well as concentration, both are considered.

The order of deposition of the minerals in the silver ores elsewhere in the county agrees with that in the silver zone west of Whitecross. The silver deposits are believed to constitute a more or less regular zone which lies flat above a concealed batholith from which they were derived. The zinc zone underlying the silver zone is exposed in several places in the county, and in the Ute vein, and probably in others, the silver ore passes into zinc ore with depth. It is believed that the changes in the ores near Whitecross can be used as an index to the probable changes to be expected with depth in the other deposits in the region.

The argentite, native silver, and ruby silver in the ores of the county appear to be almost entirely confined to vugs, although at a few places they are found in solid ore. None were found in the fresh tetrahedrite ores and it is concluded that most of the silver is in the tetrahedrite and is primary. Silver minerals found in vugs and cracks in the veins are tentatively classified as supergene.

The paper includes a discussion of the development of the idea of zonal deposition of ores. A series of experiments were made to determine the order of solubility of the minerals occurring in zones and an attempt was made to correlate these results with the order of zonal deposition. At the boiling point of water and atmospheric pressure, the order of molecular solubility is only very roughly the reverse of the order of deposition. It is believed, however, that if the relative concentrations of the metals in the magmatic waters is considered along with their solubility, that the zonal deposition can be at least partially explained on a chemical basis. Similar experiments should be performed at higher temperatures for the solubility may change under different thermal conditions.

The paper is concluded with detailed notes and descriptions of the deposits of the Whitecross area and certain neighboring deposits in Hinsdale county.

ACKNOWLEDGMENTS

This study was suggested by Dr. W. H. Emmons, and the writer is greatly indebted to him and to Dr. F. F. Grout for many valuable suggestions and for criticism. Dr. G. M. Schwartz has also given material assistance in this work and Professor R. E. Kirk has read and criticised certain portions of the paper treating the chemistry of ore deposition. The writer has also obtained great assistance in the field from Mr. R. L. Chase of Denver, Colorado, and Mr. C. E. Slocum of Lake City, Colorado, and many others at Lake City, while working in that district during the last three field seasons.

THE WHITECROSS-HURRICANE BASIN AREA

Location

The Whitecross-Hurricane Basin Area, as shown in figures 1 and 4, is situated about twelve miles southwest of Lake City, Colorado. It is a rough mountainous country, having a relief of three thousand feet. Most of the divides are 13,000 to 13,500 feet above sea level.

General Geology

The geology of the part of the area within the Silverton Quadrangle was described by Cross and Howe[1]. It is mainly a region of interbedded flows and tuffs of Tertiary age. These volcanics have not been separated on the map of the area (Fig. 1), but are separated in the report by Cross. In the central part of the area there is an inlier of granite of probable Pre-Cambrian age. The contacts between the volcanics and the granite are faulted at all except one place where exposures were examined. These faults and those in the granite and volcanics contain the ore deposits of the region.

There are three volcanic formations in the area; the Picayune andesite, the Eureka rhyolite, and the Burns latite. Of these the Picayune is the oldest and the Burns the youngest. They lie in an unconformable series and have low dips.

Besides the granite and the Pre-Tertiary dikes associated with it, there are several intrusions of Tertiary age. The most important of these are the intrusive ande-

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*Submitted to the University of Minnesota in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Geology, June, 1924.

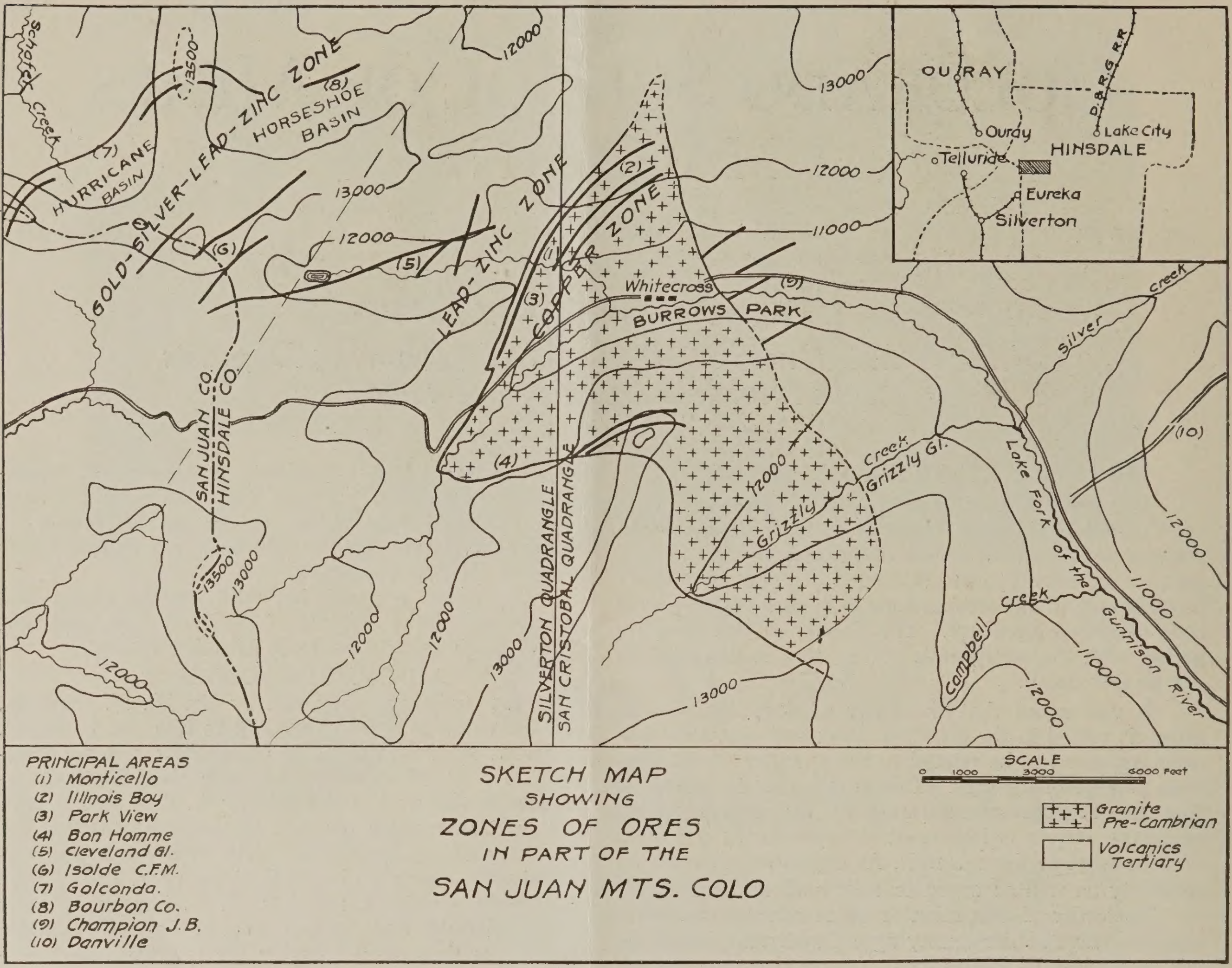


FIG. 1

site which occurs as sills in the western part of the area and the rhyolite porphyry which is intrusive into the Picayune andesite east of the granite. Concerning the relation of the granite to the volcanics, Cross[2] states: "While the fault planes show that this mass is an upthrust block, there is no means of measuring the amount of throw, and if the granite mass of Cottonwood Creek is a projecting point about which the volcanics piled up until it was covered, the Lake Fork body may perhaps be in part of that character also."

The granite is not continuous on the surface with that along Cottonwood Creek. The contact between the granite and the volcanics was found to be faulted, where ever exposed, except at the extreme southeast corner. There the tuffs lie unconformably on the granite and the plane of the unconformity dips about twenty degrees to the southeast. Near the contact the tuff contains many rounded-angular boulders of granite, some of which are six feet in diameter. Boulders of granite and pegmatite were also found in the volcanics at many other places near the contacts, but none were discovered more than two or three thousand feet away.

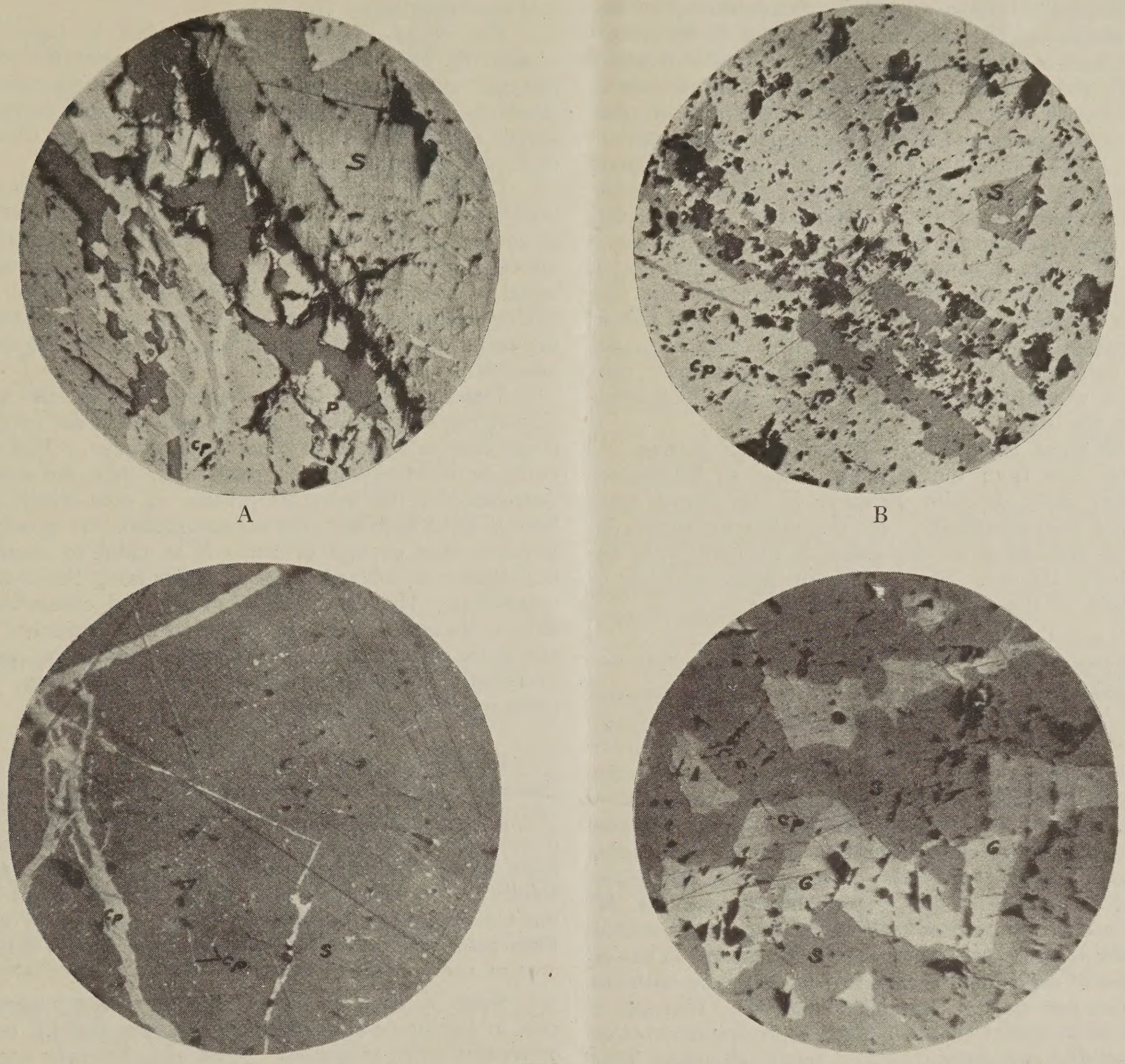
These relations are believed to confirm the suggestion of Cross that the granite represents a peak which was buried beneath the volcanics. During late Tertiary times when the region was faulted, it is believed that this peak acted as a more or less stationary element and the volcanics settled about it. This caused the faulting at the contact. Faults were formed also in the granite parallel to the contact. These latter were probably due to the shearing forces on the periphyry of the granite. Nearly all of these faults are parallel to the western contact which appears to be the most highly faulted.

The volcanics also were intensely faulted and most of the faults in the volcanics are roughly parallel to the western contact. On the western side of the granite the faulting is more intense near the granite and decreases in intensity westward. Some of the faults shown by Cross are not shown on figure 1, which is intended to give only the position of the veins.

THE MINERAL DEPOSITS

Occurrence

The veins occupy fissures of displacement. All gradations exist between simple filled fissures and veins formed largely by replacement. In most cases replacement seems to be practically confined to fragments of wall rock in the veins. In the Whitecross-Hurricane Basin Area the ores are essentially of three types: chalcopyrite ores, sphalerite-galena ores, and the gold-silver ores with small amounts of lead and zinc. A fourth type is one usually known as grey copper ore, but it usually contains considerable galena and some sphale-



A B

C FIG, 2 D

DESCRIPTIONS OF PHOTOMICROGRAPHS OF ORES

a. Sphalerite (S) in veinlets and irregular areas in chalcopyrite (Cp). This is interpreted as a replacement of the latter by the former. From the Monticello shaft, in the copper zone. Mag. 40X.

b. Sphalerite cut by veinlet of pyrite (P), chalcopyrite (Cp), and gangue. From the Park View cross-cut in the transitional copper-lead-zinc zine. Mag. 40X.

c. Sphalerite (S) with many dots and dashes of chalcorite (Cp). These dots are often associated with veinlets and are believed to grade through dashes into veinlets and to indicate replacement of the sphalerite by chalcopyrite. From the Park View cross-cut, transitional copper-lead-zinc zone. Mag. 40X.

d. Veinlets of galena (G) with included chalcopyrite (Cp) cutting sphalerite (S). The galena and chacopyrite are believed to be of the same age and later than the sphalerite. From the Golconda cross-cut in the gold-silver-lead-zinc zone. Mag 40X.

rite. This ore is sparingly developed in the Whitecross area, but is abundant in other parts of the country.

Source of Ores

The deposits of the San Juan are of the types usually attributed to magmatic waters. The abundance of volcanics in this area indicates that there is probably a batholith below, which supplied the material. These facts, together with the occurrence of the veins in all the formations, lead to the belief that the source of the mineralization is deep seated.[3] In other words, the ores of the San Juan are believed to have been derived from a subjacent batholith which is probably the same as that which furnished the volcanic material.

There is no evidence to indicate that the magmatic waters which deposited these ores differed materially in composition from those in other areas. The microstructure of all the ores, including the telluride ores, is closely similar.

Presence of Zoning

The ores of the Whitecross-Hurricane Basin area were deposited in zones. The copper zone is confined to the area of the granite. The lead-zinc zone is in the volcanics west of the granite and the gold-silver-lead-zinc zone is also in the volcanics and extends westward from the head of Cleveland Gulch. The order of the zones near Whitecross corresponds to the order of zones found in many other regions.

Although there is a zonal arrangement of the ores in the area, no large intrusive from which they could have been derived is exposed at the surface. Instead the Tertiary ores are arranged zonally out from an inlier of Pre-Cambrian granite which is believed to be above a magnetic center. The different zones might be attributed to different periods of mineralization but the evidence against this theory appears to be conclusive. There is a complete gradational series of deposits through the different zones and the bladed quartz, pseudomorphic after the cleavage of carbonates, is present in all the zones and suggests a similar metallogenetic history. The fact that no veins in the area were found displacing or cutting other veins also suggests that the veins are of the same age. Moreover some of the different types of ore grade into each other in the same vein. Thus the copper veins of Whitecross increase in sphalerite and galena at higher altitudes and the Ute vein on Henson creek, which near the surface is rich in silver passes into sphalerite with depth. The silver deposits outside of the Whitecross area apparently constitute a widespread flat lying silver zone which overlies the zinc zone.

Different Paragenesis in Different Zones

The ores from the different zones at Whitecross and from silver deposits elsewhere in the county were examined microscopically. In the different zones the order of deposition of the minerals changes with the character of the ore. The table below gives the order of deposition of the sulphides in each zone.

	Zone	Order of Deposition				
4.	Pb-Zn-Au-Ag	Py	Sph	Cpy&Ga	Cpy	Py&Cpy--2nd Gen.
3.	Lead-Zinc	Py	Sph	Cpy&Ga	Cpy	
2.	Upper Copper	Py (Cpy?)	Sph	Cpy&Ga	Ga	Py&Cpy--2nd Gen.
1.	Lower Copper	Py	Cpy	Sph	Ga?	Lillianite

The symbols used in this table are: Py for pyrite, Sph for sphalerite, Cpy for chalcopyrite, and Ga for galena.

There seems to be a definite change in the order from zone 1 to zone 4. In zone 1 the sphalerite follows the chalcopyrite. In zone 2 the chalcopyrite is later than the sphalerite and earlier than part of the galena. Finally in zones 3 and 4 the chalcopyrite is later than part of the galena. This is probably due to the decrease in concentration of copper with respect to zinc as the lower temperature zones were approached. That is, the order of deposition of salts is determined by both the quantities present and by their solubilities. If a salt is present in sufficient excess it may be precipitated before a less soluble salt present only in small amounts. That is what seems to have taken place in these deposits. The order of deposition of sphalerite and chalcopyrite is reversed when zinc was greatly in excess. In other words, the concentration of the metals in the magmatic waters seems to have affected the order of deposition.

Similar Paregenesis Elsewhere

If the change in the concentration of the metals causes the change in the order of deposition, sphalerite should be deposited after chalcopyrite where copper is the abundant metal in the deposit and before chalcopyrite where zinc is abundant. Sphalerite should also form before chalcopyrite in silver deposits if zinc is more abundant than copper as in the case just mentioned. Many other districts show such relations. That is, the most abundant sulphide appears to be deposited first. According to Schwartz,[4] sphalerite is later than chalcopyrite in the copper ores of Fierro and of Parry Sound. Finlayson[5] state that sphalerite is later than chalcopyrite in the copper deposits near Cornwall, England and in the pyritic deposits of Tuelva, Spain. In the Evergreen mine McLaughlin[6] found that the copper minerals were deposited before, simultaneously with and after the sphalerite.

In an examination of silver ores Guild[7] found that chalcopyrite was deposited after sphalerite. Bastin and Laney[8] found the same order of deposition of sphalerite and chalcopyrite at Tonopah.

The effect of concentration seems to have been noticed by Hanson[10] for discussing the relations of the minerals chalcopyrite and sphalerite in some pyritic deposits in Canada he said, "Where they are found together as a matrix to the pyrite grains, the one which is the more abundant appears to be the earlier."

Davy[11] also, in his study of the Bolivian tin-silver ores made a similar observation concerning the effects of concentration. He says, "The bismuth concentration appears to be more a question of local richness in the metal of the mineralizing solutions rather than to controlling influences of temperature, pressure, or surrounding rocks, though the higher temperature conditions are most favorable."

Thus it appears that a relation between the quantity of the minerals in a deposit and the order of deposition can be noticed in other districts also. The difficulty in determining this relation is that the relative quantities of the minerals present in ores which have been studied have not always been stated. It is believed however that enough evidence is at hand to show the importance of concentration in determining the order of deposition. The effect of solubility and concentration will be discussed later. It should also be mentioned that the order of deposition of the ores in the silver zone is practically identical with that in the silver ores from other parts of the county.

Secondary Enrichment

It is noted above that the deposits show primary changes from the surface downward. Secondary changes are also recognized in some of the deposits. Three metals, gold, silver and copper, have been enriched in these ores. The enrichment of gold was brought about chiefly by the substraction of the worthless material leaving native gold in the quartz on the outcrops of veins. Free gold was found by panning some of the oxidized ores of the gold-silver zone.

Some of the silver in the ores now being mined occurs in the silver minerals that line vugs and fill cracks or replace older sulphides. Most of it however appears to be in the primary mineral tetrahedrite.

At present the occurrence of silver minerals in vugs and cracks seems to be sufficient evidence for considering them secondary. In some cases this can be proved but in others the genesis is open to doubt. Irving and Bancroft[12] believed that the silver minerals occurring 1,200 feet below the outcrop of the Golden Fleece vein were secondary. Pyrargyrite, argentite and native silver were found in vugs and it appears to be most conservative to classify them tentatively as secondary until more exact evidence is obtained.

Silver minerals were found replacing the older sulphides in only a few cases. The two most representative examples are shown in figures 3,b and 5,f. In the first the pyrargyrite is believed to be almost certainly supergene because the specimen came from oxidized ore near the surface and because of the even, peripheral replacement of the sphalerite. In figure 5,f, on the other hand, the veinlet of pyrargyrite is irregular and is the type of veinlet found in known hypogene replacements. This pyrargyrite is believed to be hypogene. As no silver minerals other than tetrahedrite were found in the massive tetrahedrite ores, it is believed that most of the silver is in the tetrahedrite and primary. The supergene deposition of copper minerals does not seem to have been important in the ores. Covellite was found

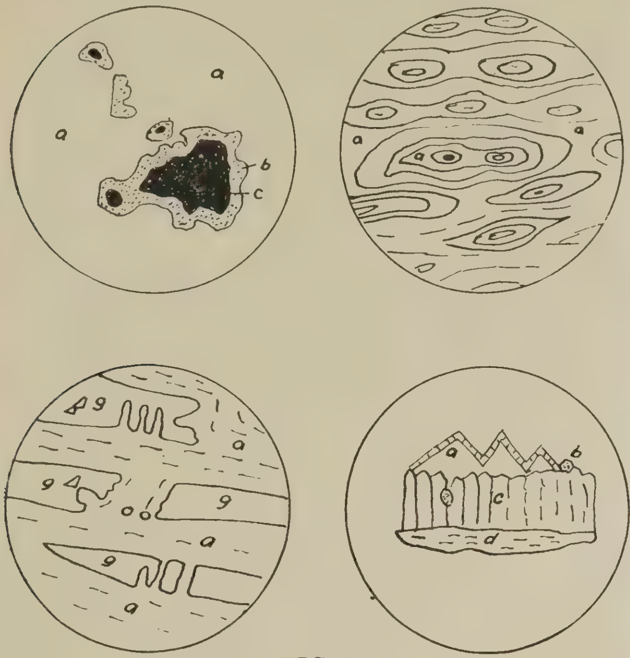


FIG. 3

DESCRIPTIONS OF SKETCHES OF ORE STRUCTURES

a Ore from the Golconda Cross-cut. Quartz crystals (C) on wall rock (d) covered with hollow carbonate crystals (a) and pyrargyrite (b). This association suggests supergene pyrargyrite. Approximately ⅔ size.

b. Ore from Shallow Workings on Golconda Claim. Sphalerite (c) in quartz and adularia gangue (a) with a mineral (b) which appears to be pyrargyrite, replacing the sphalerite. Mag. approx. 35X.

c. Lead Ore from American Contention Claim near Whitecross. An intermediate stage in the replacement of galena (g) by anglesite (a). Mag. approx. 7X.

d. Location same as figure 3c. A later stage in the same alteration. Small residual area of galena shown by black dot. Mag. approx. 2X.

in many specimens in veinlets and replacing other minerals peripherally but only in small amounts.

DEVELOPMENT OF THE THEORY OF THE ZONAL DEPOSITION OF ORES

As early as 1900 De Launay[13] stated that ores were derived from igneous magmas and that one could work out a composite vein showing the degree of relationship of the different mineral deposits to the magma, by studying a series of deposits eroded to different depths. He thought that pyrite, pyrrhotite, iron, nickel, cobalt, and copper deposits were in general closely related to the basic rocks. Connected with the granites he gave the following series: Tin, bismuth and molybdenum closely related; lead, zinc, silver, iron sulphides, nickel, and cobalt less closely related and farther up in the vein; and finally the bonanza type of gold and mercury deposits which he believed to be deposited far above the parent magma. The characteristic gangues of these deposits were given as quartz in the high temperature grading into carbonates in the intermediate temperature deposits and barite in the low temperature deposits.

The classification of ore deposits given by Beck[14] is very similar to the zonal classification in vogue today although it is not certain that he had the idea of zonal deposition. He recognized however that the deposits were related to igneous rocks and that there are deposits which represent gradations between those in his classification. This work has been translated into English by Weed[15].

Weed[16] recognized the fact that a difference in the solubility of minerals in the solutions from which they are deposited would give rise to an orderly vertical distribution of the ores. He said: "The order appears to be galena on top, passing into highly zinciferous ores below, and this into low grade pyrite."

The zonal arrangement of the ores about the Heemskirk granite was first described by Waller[17]. This work is relatively inaccessible and it is probably for this reason that it has received so little attention.

Lindgren[18] has discussed the relation of ore deposition to deep mining. Concerning the reduction of temperature and pressure as causes of deposition he said, "If it can be shown, however, that ore deposition changes in depth, gradually and generally, that change must be due to temperature and pressure." In a later paper[19] he divided ore deposits into zones depending on the depth of formation and gave a classification showing the distribution of minerals in the different zones.

The same year Spurr[20] proposed what he called the zonal theory of ore deposition. In this paper he held that ores where deposited from fluids which represented the aqueous differentiate or residue from a crystallizing magma and that as these fluids rose toward the surface under conditions of decreasing temperature, they deposited the minerals in zones. The zones were stated to be: (1) The pegmatite zone, containing tin, molybdenum, tungsten, etc., (2) The free gold-auriferous pyrite zone, (3) The cupriferous pyrite zone, (4) The galena blende zone, (5) The zone of silver and much gold, (6) The zone of earthy gangues.

The theory of zonal deposition thus seems to have been developed independently by De Launay, Waller and Spurr. Since their work appeared a number of investigators have contributed to the theory. Many of the papers describe local cases of zoning and most discuss the causes[21]. Several of these papers go into the theory of zonal deposition in much more detail than the others. Berg showed the relations of the different types of deposits to the different types of intrusives. In the "Ore Magmas" Spurr stated that ores were derived from acid, intermediate and basic magmas and gave a different series of zones from each type of magma. DeLaunay also, in his treatise elaborated on the ideas previously expressed. By means of statistical study of ore deposits, Emmons determined a composite series of mineral zones. He gave the series from the magma upward or outward as: Tin, tungsten, bismuth, arsenic, copper, zinc, lead, silver, antimony, and mercury.

From the large number of cases of horizontal and vertical zoning of primary ores that have been described, it is certain that these changes are of great importance in mining operations. The zonal order appears to be practically the same throughout the world, except that, in some areas, certain zones are missing. For this reason the most complete zonal order must be a composite one, because no complete series of zones has been described from any one area.

The decrease in the temperature and pressure of the solutions, has been suggested as the cause of the zonal arrangement by most writers. The reason for this belief is clear. The ores usually appear to be related to some intrusion and change in character as the intrusion is approached. Some have also expressed the belief that the minerals were deposited in the inverse order of their solubilities, although in no case noted was any reference made to the literature of mineral solubilities or to the solubilities of the corresponding compounds.

THE RELATION BETWEEN THE POSITION OF MINERALS IN ZONES AND THEIR RELATIVE SOLUBILITIES

It has been stated by several investigators that the mineral zones noted at many places in mining districts are due to deposition from aqueous solutions. The minerals were believed to have been deposited in order of their solubilities. Thus far however no attempts have been made to correlate the positions of the minerals in the zones with the order of their solubilities as determined by experiment.

Review of Previous Experiments

There is very little data available on the solubility of the ore minerals in alkaline solutions. The work that has been done in this field is widely scattered and very difficult to summarize. Becker[22] determined the solubility of a number of mineral salts but was chiefly concerned with those occurring in mercury deposits. He states that the sulphides of mercury, antimony and arsenic are very soluble in solutions of sodium sulphide, warm sodium hydrogen sulphide, and sodium carbonate partly saturated with hydrogen sulphide. The other minerals and compounds studied seem to have been slightly soluble in the same solutions in the following order, starting with the more soluble gold, pyrite, zinc sulphide, and cupric sulphide. The sulphides of lead and silver were said to be insoluble in the same solutions. The conditions under which these experiments were made were not stated but most of them seem to have been carried out at room temperature.

Doelter[23] determined the solubility of a number of the ore minerals in water and in a solution of sodium sulphide. The order of solubility in the sodium sulphide solutions is of most importance in this investigation and may be stated as: Chalcopyrite, zinc blende, galena, arsenopyrite, bournonite, pyrite, and stibnite. The least soluble is named first. The finely powdered minerals were heated in sealed tubes at 80° C. for twenty-eight days.

Wagner[24] determined the solubilities of copper, zinc, and lead in solutions of several salts of alkalies and alkaline earths at moderate temperatures, with and without carbon dioxide. In the absence of carbon dioxide the order of solubility, starting with the most insoluble, is copper, zinc, lead. In the presence of carbon dioxide the order is reversed.

Wells[25] has recently determined the order of solubility of different classes of compounds in aqueous solution. The hydroxide series is especially interesting because of the probability of hydrolysis of any alkaline salts in magmatic waters.

The other literature on the solubilities of the mineral salts is concerned chiefly with the silver minerals. Becker, as mentioned on a previous page, reported that silver sulphide is insoluble in the alkaline solutions which he used. Later work by Lehner[26] supports this as do the studies of Ditte. Ditte[27] states that silver sulphide is soluble in concentrated alkaline sulphide solutions but that the complex salts formed break up on dilution. Van Hise[28] stated that silver sulphide was soluble in alkaline carbonate solutions. Ravicz[29] attempted to dissolve argentite and other silver minerals in a sodium carbonate solution by boiling them for several hours and reported them insoluble.

Experimental Work

It is clearly apparent that these data are insufficient to show the relative solubilities of the common minerals in alkaline waters. Moreover, the results are more or less contradictory and in most cases the determinations were not carried out so that the results may be compared. As was seen from the review of the literature on the zonal arrangement, some of the students of the subject expressed the belief, that the zonal deposition of ores was due to the relative solubilities of the minerals. If this is true, the order of solubility of the minerals, starting with the most insoluble, should be the same as the order of the minerals in zones, starting with the minerals deposited nearest the magmatic source.

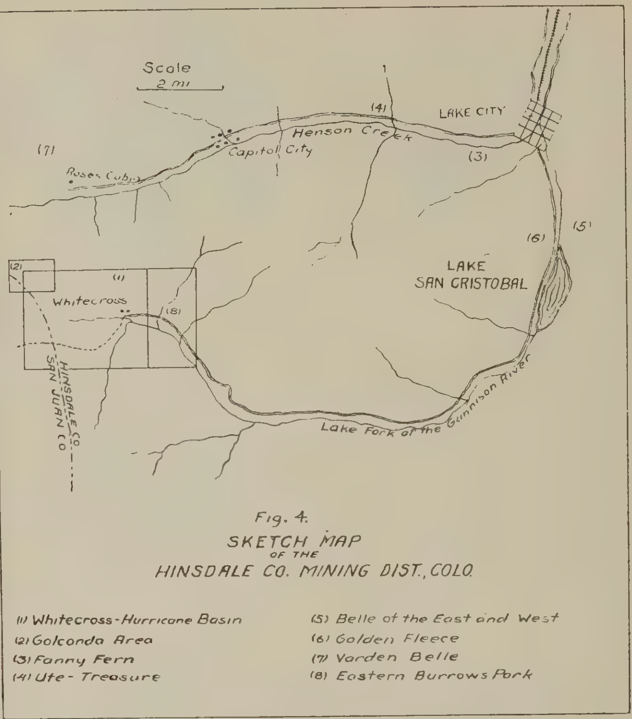


FIG. 4

An attempt was made to determine the solubility of a group of minerals whose places in the zones are well established. The solubilities must of course be in solutions of salts which occur in magmatic waters. For this reason, various solutions of salts of alkaline metals were used singly and mixed. The solubility of the minerals was determined by heating one gram of each mineral in two hundred cubic centimeters of the alkaline solutions. A five hundred cubic centimeter Erlemeyer flask of Pyrex glass was used and was fitted with a reflex condenser. A four foot straight tube condenser will prevent practically all loss of solution by evaporation.

The minerals were examined microscopically and were as pure as could be obtained. They were then ground in an agate mortar and only material between 100 and 200 mesh was used in the tests. A file was used in powdering the argentite. If the proper size file is used one can obtain a very good classification of the material. The solutions were made up to contain a total of 1% of the alkali salts selected as solvents. Each of the minerals was treated with each of the solutions shown in Table I. The solutions were kept boiling for seventy-two hours and then filtered while still hot. The flasks were drained but the minerals were not washed. The filtrates were analyzed for the principal metal in the mineral tested.

The filtered solutions were analyzed by the methods given below:

Tin: Tested for by the ammonium molybdate color test.

Arsenic: Marsh flame test.

Silver: Solutions were evaporated in test lead boats and then determined by fire assay:

Mercury: Determined gravimetrically as the sulphide.

Antimony: Determined by electrolysis of the alkaline sulphide solution.

Copper: Detected by ammonium hydroxide color reaction and by potassium ferrocyanide.

Zinc: Determined by potassium ferrocyanide titration.

Lead: Determined by ammonium molybdate titration.

Blanks were run and subtracted from all results except those for stibnite and cinnabar. It is to be regretted that lead and zinc had to be determined in this way but it was found that silica dissolved from the Erlemeyer flasks interfere very seriously with gravimetric methods and so volumetric methods were used. Careful volumetric blanks were run on these determinations and the results are the average of two or three determinations.

Conclusions from Chemical Work

These results are not as uniform as might be expected nor as accurate[20] as it is possible to make them with more refined methods. The minerals used were the best that could be obtained but they were natural crystals and not pure chemical compounds. The experiments were carried out to determine the order of solubility of the minerals in alkaline solutions and to see whether the results could be correlated with the order of deposition of the minerals in zones. It can be seen from Table I, which has the minerals in the zonal order from left to right, that for certain minerals the order of molecular solubility is not the reverse of the order of deposition. The order of solubility may change under conditions of higher temperature and pressure. Gases such as hydrogen sulphide and carbon dioxide, which are known to be present in magmatic waters, will also affect the solubility of the minerals. If, as some believe, there is a much greater percentage of alkalies present in the magmatic waters this would also affect the solubility of the minerals.

TABLE I

MILLIGRAMS OF METAL DISSOLVED AND MILLIGRAM MOLS° OF MINERAL DISSOLVED FROM ONE GRAM OF MINERAL BY BOILING 72 HOURS

200 cc. Solution	Concentration	Cassiterite	Arsenopyrite	Chalcopyrite	Sphalerite	Galena	Argentite	Stibnite	Cinnabar
Na_2S	1%	None	None*	None	6.0	7.8	Tr§	330	92
					.092	.037		1.37	.458
K_2S	1%	None	None*	None	4.7	7.0	Tr§	382	86?
					.072	.034		1.59	.428
Na_2CO_3	1%	None	None*	None	1.6	7.8	Tr§	702	None
					.024	.037		2.91	
K_2CO_3	1%	None	None*	None	1.6	6.2	Tr§	242	None
					.024	.030		1.00	
NaCl	1%	None	None*	None	2.1	5.4	Tr§	9	None
					.114	.047		.012	
KCl	1%	None	None*	None	7.4	9.8	Tr§	3	None
					.032	.027		.037	
Na_2S	5%	None	None*	None	4.3	3.11	Tr?	275	39
NaCl	5%				.066	.015		1.17	.194
K_2S	5%	None	None*	None	3.1	4.9	Tr§	327	16
KCl	5%				.047	.023		1.36	.079
Na_2S	5%	None	None*	None	2.5	6.7	Tr	471	3
NaCl	33%				.038	.032		1.95	.014
Na_2CO_3	33%								
K_2S	33%	None	None*	None	6.8	6.2	Tr?	508	Tr
KCl	33%				.130	.029		2.11	
K_2CO_3	33%								
H_2O		nd.	nd.	None	None	None	nd.	nd.	nd.

°The lower figures are in milligram mols.

*Questionable—Reagents contained a very slight trace of arsenic.

§At least .01 mg.—Possibly as much as .10 mg.

If the minerals are divided into groups: (1) cassiterite, arsenopyrite, chalcopyrite; (2) sphalerite and galena; (3) stibnite and cinnabar, then the members of group 1 which are least soluble are the minerals precipitated nearest the parent magma. The minerals of group 2, which are more soluble, are precipitated farther from the magma. The minerals of group 3 are most soluble and are precipitated farthest from the source.

But there are reversals in groups 2 and 3. Galena in some of the solutions is less soluble than sphalerite, and if for comparison the proportions of the minerals dissolved are expressed in mols; that is, if the molecular weight of the mineral is taken into consideration, then galena is less soluble in most of the solutions used. Argentite is not in the position demanded by the theory and the positions of stibnite and cinnabar are reversed.

Deposition however depends on the concentration of the metals as well as solubility. The studies of the paragenesis of the minerals in the various ores in the Whitecross district showed that the most abundant minerals are the ones that are most likely to be precipitated first. Without doubt zinc is much more abundant than lead and both are more abundant in the earth's crust than silver. Antimony also is probably more abundant than mercury. It thus appears highly probable that the order of precipitation commonly noted is modified by the concentration effect. The least soluble minerals have probably been precipitated first except when the more soluble ones were greatly in excess.

DESCRIPTIONS OF DEPOSITS THE WHITECROSS-HURRICANE BASIN AREA

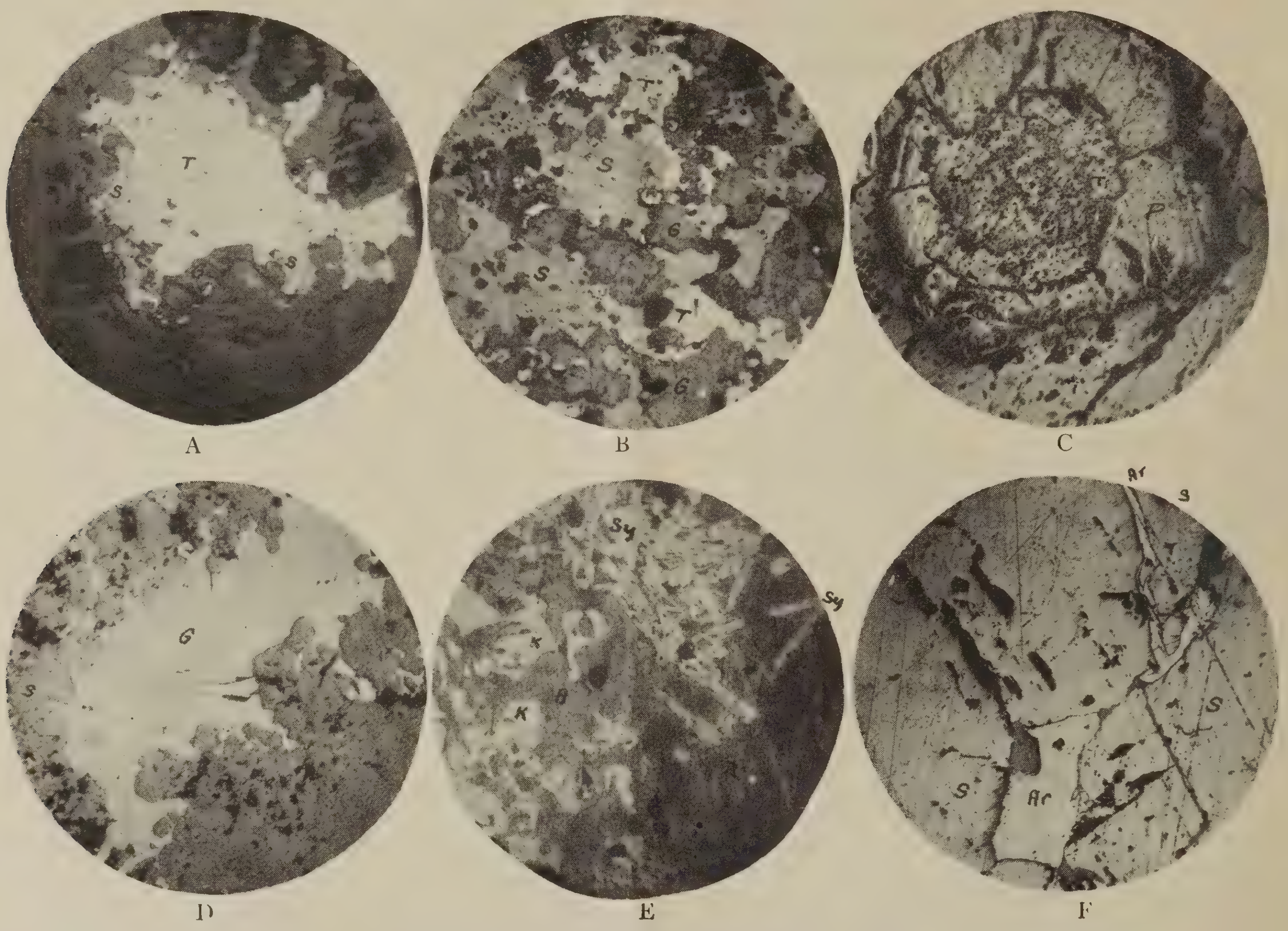
The Copper Zone

In the western side of the granite area shown in figure 1, there is a group of copper deposits which extend from the Illinois Boy mine on the north to the Bon Homme mine on the south. They occur either in the fissures in the granite or in the faulted contact[21]. These deposits are all very similar but certain differences may be noted between those at high and at low altitudes.

Chalcopyrite and pyrite are the most important sulphides, but sphalerite and galena are often seen in the workings at high altitudes such as those in the Park View, Illinois Boy, and Bon Homme mines. In the Park View chalcopyrite, sphalerite and galena are present in about equal amounts. The lowest point to which the lead-zinc ores extend is found in the fissure on the contact between the granite and the volcanics about twelve hundred feet north of Cleveland Gulch creek. A body of galena has been exposed there by two short adits.

In the low altitude workings, which are about nine hundred to a thousand feet lower than those mentioned above, sphalerite and galena are present in microscopic amounts only. These deposits are best exposed in the Monticello and other mines near the mouth of Cleveland Gulch.

In the ore from the copper zone with practically no lead and zinc, pyrite was the first sulphide deposited as it occurs in the form of corroded crystals in the chalcopyrite. Following the chalcopyrite the mineral lillianite was deposited in small amounts. Sphalerite was de-



DESCRIPTION OF MICROPHOTOGRAPHS OF ORES

a. *Hidden Treasure Ore.* Peripheral replacement of tetrahedrite (T) by sphalerite (S) and galena (G) (etched). Mag. 66X.

b. *Belle of the West Ore.* Intricate intergrowth of sphalerite (S), tetrahedrite (T), and galena (G) (etched). They are believed to have been deposited simultaneously. Mag. 66X.

c. *Belle of the East Ore.* Pyrite crystal (P) replaced on the inside by tetrahedrite (T) which also surrounds it. The tetrahedrite on the inside contains numerous corrosion remnants of pyrite. The outside of the crystal is only slightly corroded. Mag. 20X.

d. Ore from Vein just East of Granite in Burrows Park. A typical veinlet of galena replacing sphalerite. Mag. 66X.

e. *Golden Fleece Ore.* Tellurides and selenides in intimate relations. Sylvanite (Sy) in bladed crystals, Krennerite (K) in irregular areas and Aguilarite (A) (etched) forming the matrix. Mag. 80X.

f. *Varden Belle Ore.* Pyrargyrite (Ar) replacing sphalerite (S) in irregular veinlets and areas. This type of veinlet is believed to indicate that the pyrargyrite is hypogene.

posited after chalcopyrite but its relation to lillianite is not clear. The sphalerite as shown in figure 2a occurs in the form of veinlets and replacement areas cutting the chalcopyrite. Galena was deposited later than chalcopyrite but it occurs only in small quantities and its relations to the sphalerite are doubtful. Briefly, the order of paragenesis of the sulphides in this zone is: Pyrite; chalcopyrite; lillianite, sphalerite, and galena.

In the upper part of the copper zone, which contains sphalerite and galena, pyrite was the first sulphide deposited. The pyrite was corroded by chalcopyrite and sphalerite. The sphalerite was cut by many veinlets of chalcopyrite which are certainly later, but part of the chalcopyrite corroding the pyrite is probably earlier than the sphalerite. Galena appears in the sections both cutting the chalcopyrite and alternating with it in small veinlets. This is believed to indicate that the period of galena deposition coincided with that of the chalcopyrite but also followed it. Several specimens were found which showed a later generation of pyrite and chalcopyrite cutting the older minerals, as can be seen in figure 2b. Faces of chalcopyrite crystals occasionally seen in these ores probably belong to this late generation.

The ores of this zone and the one below differ in the presence of numerous small inclusions of chalcopyrite in the sphalerite. These can be seen clearly only at magnifications as high as 160 diameters. Usually they are found as more or less oriented dots which grade into rod-like shape. Others who have described such inclusions do not agree concerning their origin. Thompson[32] and Teas[33] believed them to represent the replacement of sphalerite by chalcopyrite and Schneiderhohn[34] thought that in some cases they were due to the "entmischung" (unmixing) of a solid solution. Figure 2c shows a typical area with these inclusions. As can be seen, the dots are in several places arranged in lines and in some of these lines there is a connection between two or more of the dots which forms what may be called a rod or dash. These dashes are thought to be the beginnings of veinlets and this interpretation implies that the chalcopyrite is later than the sphalerite.

The order of deposition of the minerals in the upper part of the copper zone may be summarized: (1)

Pyrite, (2) sphalerite, (3) chalcopyrite and galena, (4) galena; with a later generation of pyrite and chalcopyrite and probably some chalcopyrite between (1) and (2).

The texture of the chalcopyrite-sphalerite intergrowth described above is believed to be similar in origin to one found in the vein quartz. Quartz with a parallel bladed structure is frequently found in the outcrops of the veins. This structure is formed by the weathering of carbonates and barite which have been replaced along the cleavage by quartz[35]. At one place on the American Contention outcrop, all of the carbonates had been replaced but the texture was brought out by the difference in the character of the earlier and later quartz. A thin section of the quartz from a nearby point in this vein showed corroded remnants of carbonates in the quartz. It seems probable from this that the veins may have been highly calcareous at an early stage in the mineralization.

The only evidence of supergene deposition of sulphides in the ores was an occasional veinlet of covellite. A noteworthy case of the oxidation of galena however, was found in the lead shoot on the American Contention. The lead minerals occurred almost free from other minerals in a streak six inches to one foot wide. The galena had been oxidized along the cleavage to anglesite. An intermediate stage in the oxidation is shown in figure 3c. The final stage in the oxidation was the formation of solid anglesite. This texture as can be seen in figure 3d, looks much like the flow structure of some of the lavas in the region.

The Lead-Zinc Zone

To the west of the zone containing the copper ores described above, there is a zone of lead-zinc veins. They occupy fault fissures in the volcanics and usually contain sphalerite and galena in about equal amounts although in some of the prospects one or the other may predominate. Chalcopyrite is present in small quantities only. The vein quartz of this area is also different from that of the copper zone. Much of it is finer in texture and the fine textured quartz is often darker in color than the quartz of the copper vein. Bladed quartz, pseudomorphic after the cleavage of carbonates, occurs in these veins also.

The specimens studied microscopically were obtained from the prospects on the north side of Cleveland Gulch. In these specimens pyrite was the first sulphide deposited and was followed by sphalerite which corroded it. The sphalerite was later cut by veinlets and replaced in irregular areas by chalcopyrite and galena. Most of the chalcopyrite is younger but some of it appeared to have been deposited simultaneously with the galena.

The Gold-Silver-Lead-Zinc Zone

From the head of Cleveland Gulch westward there is a group of veins with gold, silver, lead and zinc which constitute a well defined zone. They contain smaller amounts of sphalerite and galena and larger amounts of gold and silver than those to the east.

Most of the veins are in the system of fissures which cross Hurricane and Horseshoe Basins and the region at the head of Cleveland Gulch. The Isolde mine is at the east end of this group and is reported to have produced about $100,000. The vein occupies a branch of what Cross has named the Cinnamon fault. The deposit is in a tuffaceous phase of the Eureka rhyolite resembling the Burns latite. The vein is a typical breccia vein and the highest values appear to be in the "blue chalcedonic quartz" which seams and cements the altered rock fragments. This type of vein quartz is much more abundant in this area than that described on previous pages. It is considered by the prospectors as a favorable sign for ore. There are few metallic minerals visible in this ore except a small amount of pyrite. Some of the material found on the dump gave assays as high as $3,000 per ton. The values are in gold and silver and these metals are present in about equal weights. One specimen contained a mineral in bladed crystals which appeared to be calaverite[36].

The C. F. M. group of claims lie between the Isolde and the Golconda and are on the fissures which cross the head of Horseshoe Basin and Wood Mountain. The deposits are very similar to the Golconda group described below.

The Golconda Mines Consolidated is exploring the large vein shown on figure 1 crossing Hurricane and Horseshoe Basins. This vein is one of a system of veins which are more or less parallel and occupy normal faults. The Golconda veins show the greatest displacement of any of the group and also has the flattest dip.

With one or two exceptions, notably the Bourbon County property in Horseshoe Basin, the ores of this area are silicious gold-silver ores with small amounts of sphalerite and galena. The Bourbon County ore contains considerable lead and zinc.

Specimens for microscopic study were obtained from the Golconda cross-cut in Hurricane Basin, the Golconda claim in Horseshoe Basin and the Bourbon County claim. In all of the specimens except one, sphalerite was the first mineral to be deposited. In that specimen pyrite preceded the sphalerite. Following the sphalerite in most cases galena and chalcopyrite were deposited together as shown by the way in which they cut and replace sphalerite. This relation is shown in figure 2d. Usually the chalcopyrite deposition continued somewhat longer than the galena and some of it in nearly all cases cuts the galena. One specimen from the Golconda cross-cut showed a late generation of pyrite and chalcopyrite.

In the superficial workings leaching has taken place to depths as great as one hundred feet. Pyrargyrite is frequently found in vugs in this leached ore. A thin section of the high grade oxidized ore from the Golconda claim showed that the quartz, with which is associated a little adularia, was in part formed by deposition from solution in the fissure and partly by replacement of the wall rock. In this primary quartz and adularia a few grains of sphalerite were found which had been replaced around their periphery by a mineral believed to by pyrargyrite. The relations are shown in figure 3,b. The replacing mineral was black and had a purplish internal reflection. The relations certainly suggest supergene deposition. Argentite also was seen in vugs in this ore.

A noteworthy association of pyrargyrite with the gangue minerals was found at a depth of about three hundred feet in the Golconda cross-cut workings. Figure 3,a illustrates the occurrence of the minerals. Resting on the quartz were rhombohedral crystals which proved to be hollow. Both their inner and outer surfaces were coated with minute, apparently rhombohedral crystals. All of this crust was stained with limonite and contained chiefly iron and carbon dioxide. This solution and redeposition of carbonates associated with pyrargyrite appears to be strong evidence of supergene deposition.

COMPARISON WITH NEIGHBORING DEPOSITS

The ores of certain deposits in Hinsdale County near the Whitecross-Hurricane Basin area were collected for purposes of comparison and study. The location of the deposits can be seen on the key map, figure 4. These ores were chosen particularly to study their paragenesis as revealed by polished surfaces. The main features of the geology of the deposits were described by Irving and Bancroft[31] before the development of mineralography.

Fanny Fern Ore

The Fanny Fern is on the south side of Henson Creek a mile and a half above Lake City. Specimens were collected from the back of the stope on the main level. The ore at places was coated with azurite, malachite and smithsonite but no leaching had taken place. Macroscopically, the ore appeared to be a mixture of tetrahedrite and galena in a quartz and barite gangue. Microscopically, the relations between the different minerals are very distinct. Quartz and barite were the first minerals to be deposited and the barite was slightly corroded by the later sulphides. Sphalerite was deposited after the gangue and was followed by tetrahedrite which cut it in irregular vein-like areas and replaced it along contacts with the gangue. Galena was deposited after the tetrahedrite and occurs as veinlets in both the earlier sulphides. These veinlets run in all directions and are very irregular. They send pointed projections out into the sphalerite and tetrahedrite. Small amounts of chalcopyrite were seen in the ore. They are clearly later than the sphalerite and tetrahedrite but their relationship to the galena could not be determined. Covellite was the only sulphide seen in polished sections which appeared to be of supergene origin. It occurred in veinlets and replacing the borders of tetrahedrite areas. Specimens of pyrargyrite were said by the miners to occur in cracks in the wall rock but no silver minerals were seen under the microscope other than tetrahedrite which is primary and which apparently is the source of most of the silver.

The Ute and Hiden Treasure Ores

The Ute and Hidden Treasure mines are three or four miles above Lake City on the north side of Henson Creek. Both are on the same vein. The ores studied were composed of tetrahedrite, sphalerite and galena in a gangue of quartz and barite. In some specimens, the sphalerite was clearly earlier than the tetrahedrite which cut it in a number of places. In other specimens the relations were reversed and the sphalerite replaced the tetrahedrite along contacts with the gangue as is shown in figure 5,a. In many specimens the order of deposition was doubtful. Galena appears everywhere to be later than these two minerals. Chalcopyrite was deposited in small quantities both with and after the galena. No silver minerals other than tetrahedrite were found in the microscopic examination of the ore but specimens were seen in which wire silver occurred on the quartz crystals in vugs.

The Belle of the East and the Belle of the West Ores

The Belle of the East and the Belle of the West mines are about three miles southeast of Lake City on the Creede road and are on parallel veins. The ores of the two are practically identical as might be expected since the veins are only about one hundred and fifty feet apart. The ores consist of tetrahedrite, sphalerite, galena and a small amount of chalcopyrite in a gangue of barite and quartz. In most cases the order of deposition of the minerals was pyrite, sphalerite, tetrahedrite, galena and chalcopyrite. An exception to this order was found in one polished section in which sphalerite, tetrahedrite and galena appear to have been deposited simultaneously. They occur in the intricate intergrowth shown in figure 5b. An unusual texture also found in these ores is shown in figure 5c. The interior of the pyrite crystal shown has been replaced by the tetrahedrite while the exterior is almost unaffected. Tetrahedrite was the only silver mineral seen in the ore and that is apparently primary. The only supergene sulphide seen was the usual covellite which is found in small veinlets.

Eastern Burrows Park

Eastern Burrows Park or the area east of the Whitecross granite is shown on figures 1 and 4 and is different in several respects from the area west of the granite. The veins strike northeast or at right angles to the fault between the granite and the volcanics. There has been considerable movement along the contact fault since the mineralization and the veins which were traced to the fault ended abruptly and their continuations were not found. The ores in this area are more complex than those to the west and contain chalcopyrite and sphalerite in almost equal amounts. An exception to this is the Champion vein which occupies a larger fissure than most of the others and contains principally pyrite and chalcopyrite. The ores also differ from those to the west in that nearly all of the polished specimens showed tetrahedrite. The ores of this area are not arranged in zones. There does however appear to be a slight change in some of the veins but it is unimportant. Another difference in the veins is the presence of rhodochrosite. These veins correspond better to a composite vein made up from different parts of the county than to any single vein elsewhere. Sphalerite and chalcopyrite are in about equal amounts, with tetrahedrite and galena in smaller amounts.

The order of deposition of the minerals in these veins also suggests the idea of a composite vein. The order is: Pyrite, chalcopyrite, sphalerite, tetrahedrite, galena and chalcopyrite. The later chalcopyrite was deposited in part simultaneously with the galena and tetrahedrite and in part later than both.

The Varden Belle Ore

The Varden Belle mine is on the mountain north of Rose's Cabin. (Figure 4.) The ore consists of sphalerite and galena with some chalcocite and chalcopyrite and carries high silver values. Pyrargyrite can be seen under the microscope and occurs as veinlets in the sphalerite and replacing the galena in irregular areas along contacts. One of the veinlets can be seen in figure 5f. This veinlet is interpreted as hypogene because of its similarity to others of known hypogene origin. The relations of the chalcocite are not clear. It occurs as a filling in the gangue and does not seem to have replaced other minerals. The order of deposition of the minerals is: Sphalerite, galena and chalcopyrite followed by pyrargyrite.

The Golden Fleece Ore

The Golden Fleece mine is on the mountain, west of the north end of Lake San Cristobal. It is noted for its high grade gold telluride ores. In polished sections eight different metallic minerals can be distinguished: Krennerite (a telluride of gold and silver), sylvanite (a telluride of gold and silver), aguilarite (a sulphoselenide of silver), tetrahedrite, sphalerite, galena and pyrite and an unidentified mineral which is grayish white in polished section and is tarnished irridescent by hydrochloric acid and ferric chloride but is negative to nitric acid and potassium cyanide. No petzite was discovered.

The relations of the first three named are shown in figure 5f. The sylvanite occurred in all cases in blades in the krennerite and aguilarite. The aguilarite was often intricately intergrown with the krennerite and at some places appeared to be replacing it. In general they appear to have been deposited so close togther that their exact paragenetic relations are doubtful. Tetrahedrite, sphalerite and galena were not found closely associated with the tellurides and the selenide and the relations between the two groups of minerals could not be determined. The order of deposition of the sulphides however was sphalerite, tetrahedrite and galena. Crystals of pyrargyrite were seen in vugs in the ores. These were found at the same horizons as the tellurides but were not associated so that the paragenetic relations could be determined in polished sections but as no tellurides were found in vugs the pyrargyrite is believed to be later.

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BASKETBALL IS OVER

Miners Finish in Sixth Place as Greeley Teachers Take Championship

THE Orediggers were forced to concede the last basketball game of the season to Aggies, after fighting for two extra five-minute periods. The final score stood 36 to 35 in favor of the Farmers. The game was one of the most sensational played in the entire season. The regular period of play ended with the score tied at 31 points each. The Miners came through early in the extra period and tossed two throws, and a victory appeared certain, but just as the gun was being fired, Williams, Aggie guard, tossed in a long shot that again tied the score.

Both teams scored a field goal in the second extra period, but Wannermark, substitute Aggie guard, made good on a free throw that sewed up the game that closed the season for this year.

The Mines team wound up the season in sixth place with an average of .300, having won three conference games and lost seven. The Orediggers scored 247 points on their opponents, who scored 291 points against the Dynamiters. Greeley Teachers finished in first place.

Personals

W. Ray Cox, '02, U. S. Mineral examiner, stopped at the Alumni office recently, accompanied by *William Fair, ex-'02,* of Boulder. Cox is making a sweep of the Western states for Uncle Sam and is spreading the good news of the Alumni association wherever he goes. He and Fair were interesting visitors and we hope to receive more like them.

George K. Taggart, '03, has been located by *Wallace Lee, '04,* who writes in that Taggart is the Taggart of Corzelius Brothers & Taggart, drilling contractors of Eastland, Texas. Much obliged Wallace. By the way, he is located at Pecos, Texas, with the P. V. Petroleum Co.

Arthur Clark Terrill, '05, formerly professor of mining engineering at Pei-Yang University, Yientsin, China, is now employed by the State Mining Bureau of California as a petroleum engineer, with offices at Los Angeles.

A. H. Bradford, '09, has moved his office to 620 Pacific Finance Bldg., Los Angeles, Calif.

Charles Oram, '13, were rejoicing over the arrival of a son, Robert Stanley, born Jan. 29th, but a short time later the family received a call from the Grim Reaper and little Mary Naeda, 6 years old, passed away March 1st. The alumni extend their heartfelt sympathy to Charlie.

Harry Fiske, '21, sales engineer for Ingersoll-Rand, in sending in his subscription money, states that the Magazine has been greatly improved and that he knew more would subscribe for it if they saw it in its new dress. A good hunch, Harry.

Paul Grant, '23, is with the Humphreys Corporation as a geologist. He is temporarily located at Jacksonville, Texas.

Ronald Walker, '24, has accepted a position with "El Aguila" at Puerto, Mexico. He will do geological work.

Lewis Height, '24, is assistant foreman for the Alamo Coal Co. mine at Alamo, Colorado.

Ed. Cole, '25, may be addressed at Box 1595, Tulsa, Oklahoma.

Douglass Evans, '25, is now located at 236 Lime Ave., Long Beach, Calif.

Maxwell L. Euwer, '25, writes in that he is very much satisfied with his position with "El Aguila," Apt. 86, Puerto, Mexico. He writes: "The climate here is no equal to that of Colorado weather, I have been here nine months now and am still waiting for the dry season. We have lots of mosquitos, stinging flies and gnats to keep us company. I am living in a drilling camp with about 80 Americans. (I had better say Texans, for they are all from around Houston.) Ermil Caster is working for the same company and we see each other now and then. The main object of this letter is to join the Alumni Association. I should like to receive the Magazine and keep in touch with the other Miners who have gone out."

BASEBALL SEASON BEGINS

Gallagher Elected Captain; Six Lettermen Are Back

THE letter-men elected Eugene F. Gallagher captain of this year's baseball team. Gallagher is well qualified to lead the team, as he is popular with the fellows and has considerable experience. He has made his letter the past two seasons, playing in the left field and as shortstop. His experience before coming to Mines was received with Manual and Regis High School teams of Denver. Shanty seems to have talent for any position, as he is trying out for catcher this season. The baseball lettermen in school are Look and Volk, fielders; Del Rio, pitcher; O'Connor, shortstop, and Sotock, second baseman. These men are all juniors except Volk and O'Connor, who are seniors.

The inclement weather has made it impossible to have much outdoor practice. Several men are going on the Junior Trip and this will cause them to miss ten days of practice and also the game with Regis College which is slated for April 10. Coach Courtright has a big job getting a team in shape for the first conference game with Denver University, April 16. Two practice games were scheduled for last week but were cancelled because of the muddy field. A game will be played with Mesch's team from Denver this week whenever the weather permits. Other practice games are being arranged, but a schedule cannot be announced because of uncertainty of the spring weather.

The entire squad is now working in the gymnasium. There are thirty men signed up for baseball, but the squad will be cut as soon as enough good practice can be gotten to show up the best men.

SOTOCK BASKETBALL CAPTAIN

MIKE Sotock, veteran forward, has been elected captain of the 1927 Mines basketball team. Sotock has made three letters in basketball and two in baseball, and was the outstanding long shot artist of the past season. Sotock's experience has won for him the confidence of all of the men, and should make a worthy leader of the 1927 team.

OHIO CLUB DANCE

About forty-five couples enjoyed the carnival dance given by the Ohio club, following the signal victory of Mines in the C. C. game. Profusely decorated, the hall in Guggenheim presented an attractive appearance, while the use of serpentine aided materially in the effect produced. Patrons and patronesses at the dance included Professor and Mrs. Walter Risley and Captain and Mrs. Henry Hutchings.

COLORADO MAPS BIBLIOGRAPHY

The latest number of the Colorado School of Mines Quarterly contains the most complete bibliography on Colorado maps yet published. Professor J. Harlan Johnson is the author of the paper.

The paper contains an alphabetical list of all U. S. G. S. topographical sheets made in Colorado. There follows a list of all maps appearing in geological folios, annual reports, monographs, professional papers, bulletins, and water supply papers. A list of maps in the old Hayden Survey is also included. All maps published by the Colorado Geological Survey are also listed. A complete cross index in the back of the paper makes a complete reference for all maps published on a given area.

TELEPHONE FIFTY YEARS OLD

On March 10, 1876, the first message was transmitted over the telephone. From his laboratory on the top floor of the old house in Exeter place, Boston, Mr. Bell telephoned to Thomas H. Watson, his assistant, in another room thirty feet away.

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Fifty years ago today there was one line of wire, thirty feet long. Today the total miles of wire in the system is 45,473,540. There are 386,064 miles of pole line. Fifty years ago today Mr. Bell and Mr. Watson were the "telephone men." Today the total number of men and women employed in the Bell system is 293,095. The investment today in the Bell system plant reaches the enormous sum of $2,938,000,000.

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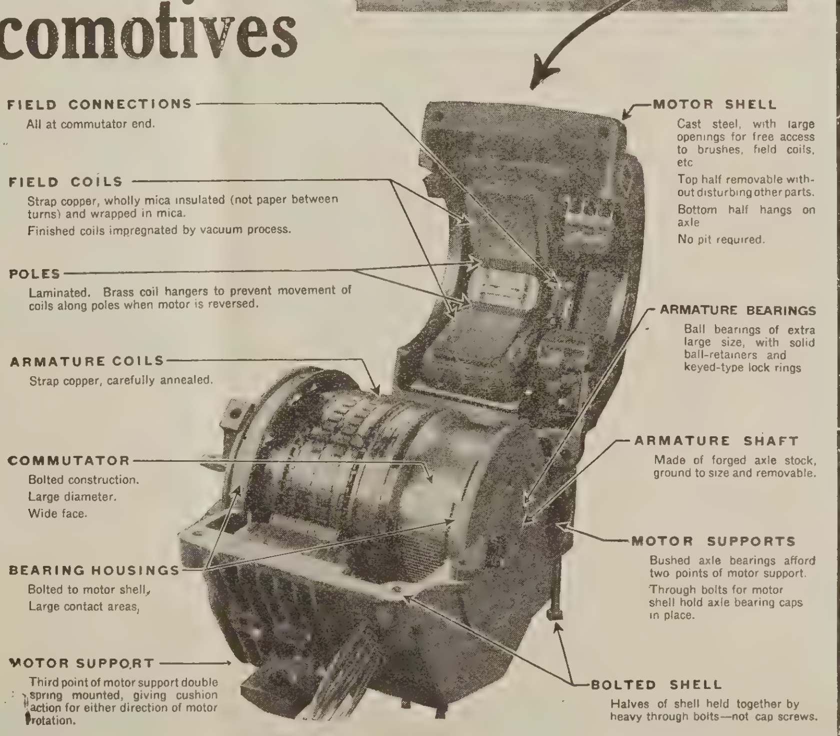
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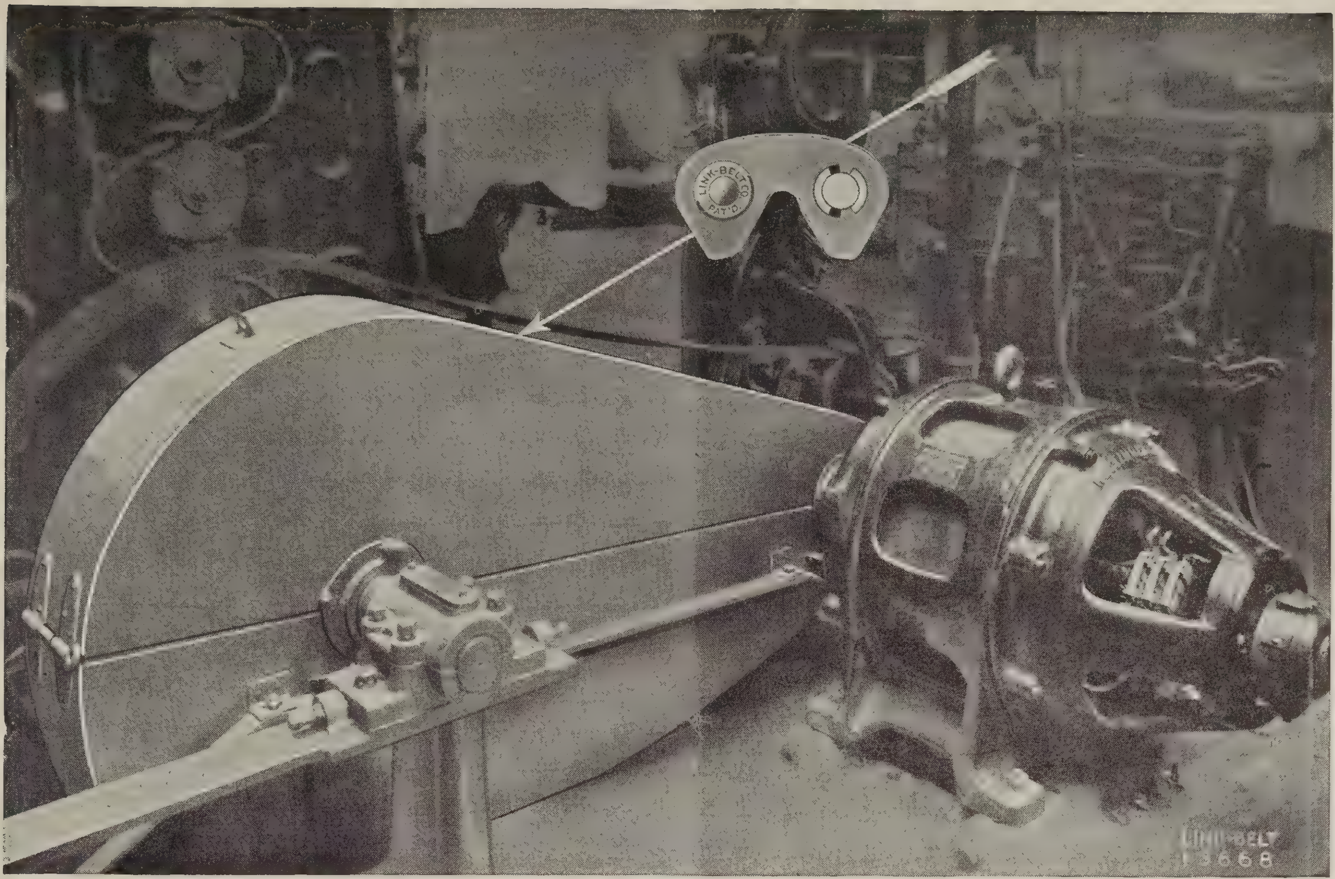

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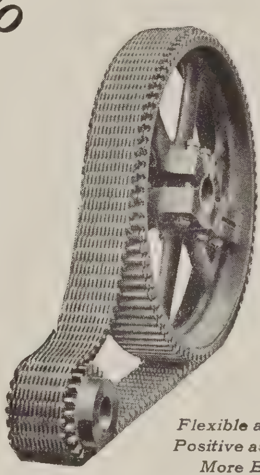

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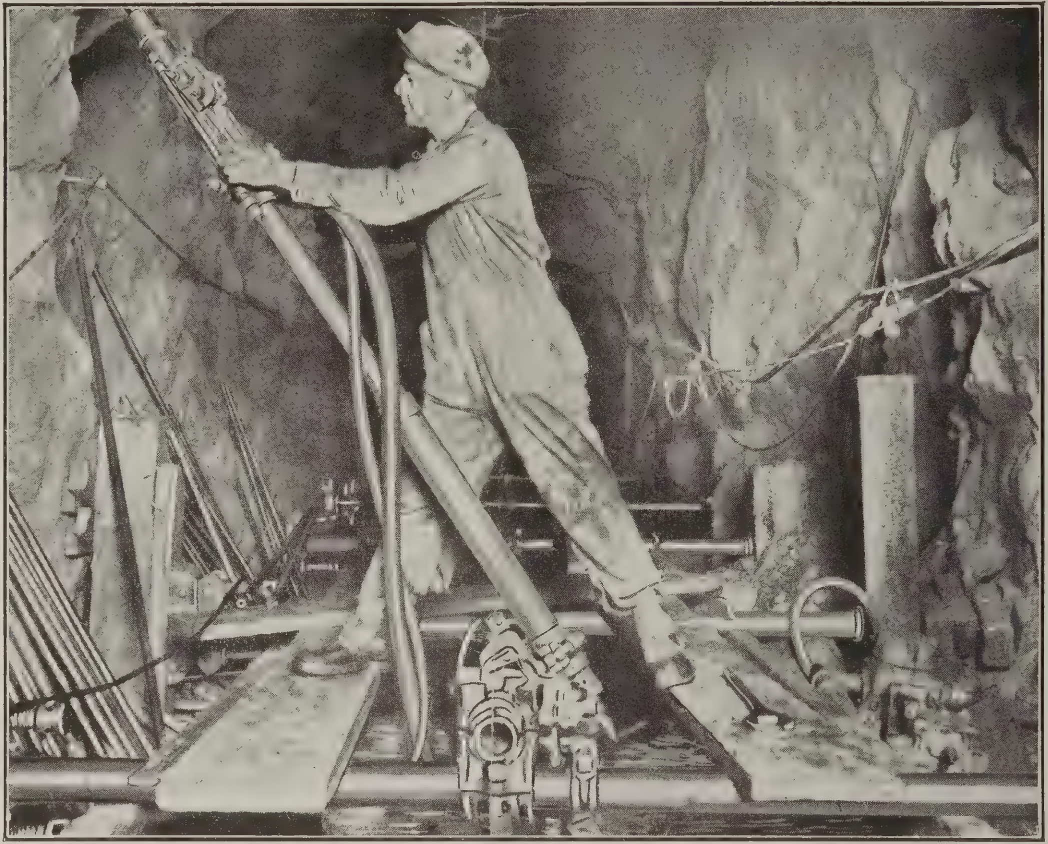

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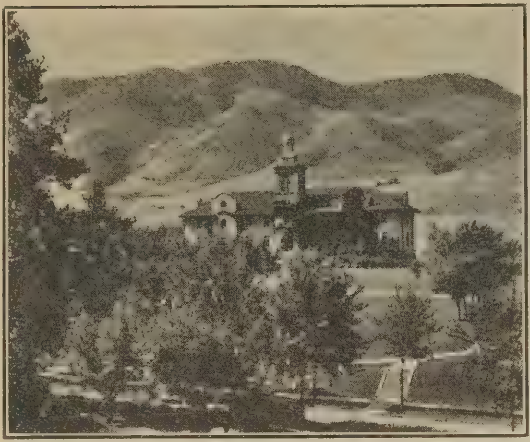

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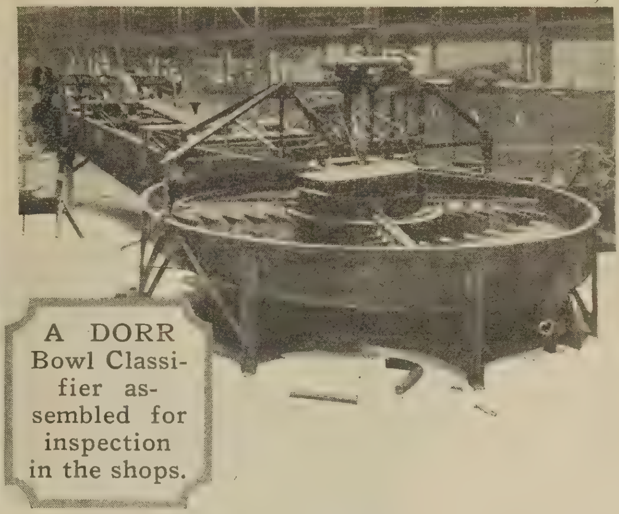

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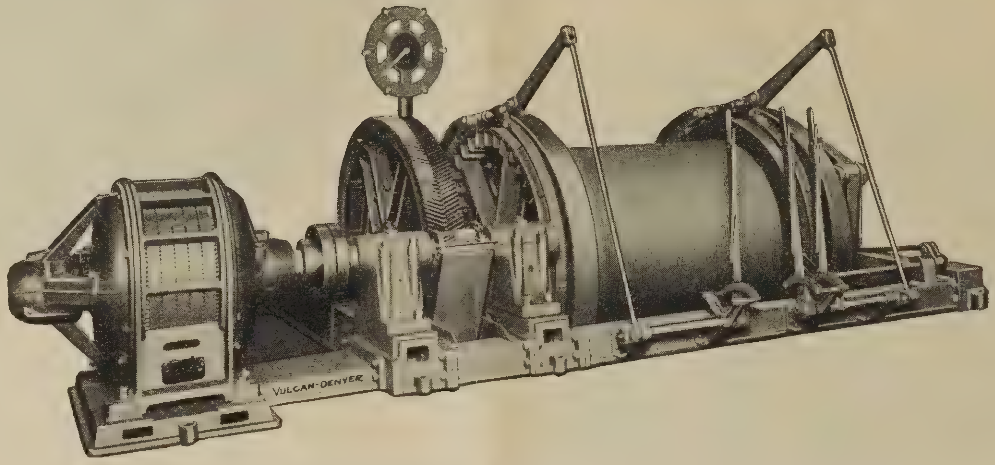

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COLORADO SCHOOL OF MINES MAGAZINE

Published every month in the year at Golden, Colorado, by the Association of Alumni of the Colorado School of Mines. Entered as second-class matter at the postoffice at Golden, Colorado. Address all correspondence, including checks, drafts and money orders, to the Colorado School of Mines Alumni Association, Box 98, Golden, Colorado.

M. R. (Monty) Budd, '24, *Editor*

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The Ox Woman

On an East Indian farm, where the crop is tea, a wooden plow turns up the rich black soil. A woman drives, another woman pulls—and a black ox pulls beside her.

Six hours under a tropical sun, a bowl of cold rice—and six hours more. Then the woman goes to her bed of rushes, and the beast to his mud stall. Tomorrow will be the same.

The American home has many conveniences. But many American women often work as hard as their Oriental sisters. They toil at the washtub, they carry water, they churn by hand—all tasks which electricity can do for them at small cost, in half the time.

The labor-saving possibilities of electricity are constantly becoming more widely recognized. And the social significance of the release of the American woman from physical drudgery, through the increasing use of electricity in and about the home, will appeal instantly to every college man and woman.

The electric light, the electric iron, the vacuum cleaner—the use of electricity on the farm for pumping water, for milking, and for the cream separator—are helping to make life happier. General Electric research and engineering have aided in making these conveniences possible.

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The
COLORADO SCHOOL OF MINES
MAGAZINE

VOLUME XV. APRIL, 1926 NUMBER 12

Editorial

Connecting School and Alumni

WITH its ultimate aim to connect the alumni with the school in a living, personal manner, President Coolbaugh has launched a campaign that is winning much favorable criticism from all friends of the school. Stating that we need good engineering material at Mines and that alumni can help obtain this material without much effort, the President has sent letters to all graduates whose addresses are known, acquainting them with the school's conception of engineering raw material.

Frank Reinhard, '05, president of the Alumni Association, follows with a letter urging alumni to organize chapters in the various cities in the United States and foreign countries. He states in his letter that the primary business object of such an organization is to get in touch with promising young men who have the ability and natural qualifications of engineers. Inasmuch as both these letters are being broadcast to all members of the alumni, it is not necessary to reproduce them here.

President Coolbaugh's appeal for young men has struck a responsive chord with graduates and the office now has a list of several hundred names of promising young men, recommended by alumni. If the spirit is continued the beneficial effect on Mines will be most refreshing. It is a definite constructive step, designed to harmonize the school and its product—the alumni.

Commencement Day

COMMENCEMENT Day is May 21. It is the day which should bring Alumni back to Golden. Of course, most of our graduates are so far away that they find it impossible to make the journey to Golden for the greatest occasion of the college year, but to those who can possibly make the trip, get ready and you'll never regret it.

The Annual Banquet

THE annual banquet and business meeting of the Colorado School of Mines Alumni Association will be held at Hotel Albany, Denver, Colorado, May 22nd, at 6:30 sharp. Reserve the date. Price is $1.50 per plate. Make reservations with the assistant secretary now.

Football Again

THE article on Football, by E. K. Hall, chairman of the rules committee, which appears in this issue, was originally prepared as an address given at the Sun's banquet for its All-American football team. The alumni magazines of the country have commented on it profusely but the comment by the Columbia News seems to be most appropriate. We quote as follows:

"The ghost of football walks again in this week's News. It is a substantial ghost this time because Mr. Hall, the author of the article which we reprint, is now and has been one of the men who, believing in the inherent value of football as a game for college boys to play, has guarded its reputation and protected it against assaults from its enemies. He is typical of the best exponents of the sport, as anyone, who reads this article will speedily discover. Anyone who, invited to speak at a dinner in honor of an "All-American" team, has the courage to tell the promoters of a popular idea that their efforts are against the best interests of the game, and to attack everything that the dinner itself typifies, is a real champion. If football had more of his calibre on its roll of proponents we would hear less of its evils."

Officers Are Nominated

NOMINATIONS for officers of the Alumni Association for the coming year are announced as follows by the nominating committee:

For President—E. R. Ramsey, '12, Denver; J. M. Kleff, '06, Leadville, Colo.; Harvey Mathews, '13, Golden.

For Vice President—H. R. Van Wagenen, '06, Los Angeles; Otto Herres, '11, Salt Lake; George Roll, '19, New York City.

For Secretary—G. B. Clark, '01, Denver; R. K. De Ford, '20, Denver.

For Treasurer—Earl Bilheimer, '20, Bonne Terre, Mo.; W. C. Page, '15, Salt Lake.

For Member Executive Committee—C. C. Malstrom, '00, Denver; L. C. Thomas, '12, Denver.

The nominating committee, appointed by President Reinhard was composed of J. W. Johnson, '01, L. B. Eames, '05, Donald Dyrenforth, '12, David C. Dodge, Jr., '15.

College Football

What Is to Become of It? National Grid Leader Presents His Side of Game to Group of All-Americans

By E. K. Hall

Chairman, Football Rules Committee

I WOULD like to state briefly why in my judgment the game is the great game that it is. I would like to reply to certain criticisms that are being made of the game today, and I would like to call to your attention, as friends of the game, certain tendencies which unless corrected will in my judgment go far to impair the almost universal esteem in which the game is held.

Why Football Is a Great Game

I do not need to argue to this group that football is a great game. It may help, however, if in our consideration of what is necessary to protect its best interests, we stop for a moment and ask ourselves the question: why is it such a great game? I am satisfied that the answer is found in the fact that the game contains practically every element essential to the highest type of sport. It offers rare opportunity not only for physical strength, agility and speed, but for mental alertness, resource and initiative. It calls for and develops confidence, courage and nerve. It affords opportunity for the exercise of all these qualities in every variation with kaleidoscopic suddenness. Its continual flashes of physical contact test the temper as almost no other game and afford continued and invaluable experience in developing its control. It develops a fine quality of sportsmanship. It teaches the value of painstaking preparation and of attention to details.

But above all, and this is the point of transcendent importance, it is outstandingly a team game with all of the opportunities of and rewards for team play. The thrill that comes from individual accomplishment alone and unaided, whether in work or play, is one of the richest rewards of effort but it pales into insignificance when compared to the richness of the rewards for joint accomplishment.

Victory alone and unaided is sweet but there is nobody to really share it with. Victory shared with others in a common cause is infinitely sweeter. Defeat or failure in single-handed effort often leaves a man oppressed with overpowering lonesomeness. Defeat in joint effort in a common cause and the consciousness of all having done their best makes friends for a lifetime.

A college daily in one of our great colleges whose team had acquitted themselves during the past season with great credit published the answers to a questionnaire which it had sent to each member of the team at the close of the season. One question read as follows: "What feature of the season did you enjoy the most?" Nine out of eleven, as I recall it, answered "the association with the other fellows on the team."

Football in my judgment is the finest team game the world has ever produced and that is the principal reason it is such a great game.

Why Is the Game So Popular?

The next question we might with profit ask ourselves is why is the game so popular among those who do not participate in the game. Each year for the last twenty years, the game has steadily increased in popularity. Attendance at the important games is limited only by the capacity of the stadiums. We only have to go back twenty years, however, to recall a time when the game was under almost universal criticism. And except in a few end-season games where an ancient rivalry was responsible for large attendance, there was little public interest in the sport.

The result of the games was generally a foregone conclusion. The injuries were frequent and often serious. Players found the game a grind and spectators found it monotonous and uninteresting. It was mass play against mass play. A premium was put on beef, and the lighter team or the team from the smaller college seldom had a chance to win. The result of the games could be predicted almost to a certainty in advance. Formation and style of play permitted and invited unsportsmanlike tactics. Officials deliberately ignored infractions of the rules. They were so frequent and difficult to detect.

Changes Remove Evils

Friends of the game working together gradually through changes in the playing rules removed the conditions which were harmful to the game, and mass play was prohibited. The defense which in those days made open play and broad strategy almost impossible was weakened by the introduction of the forward pass. The pass has now been developed to such a point that it keeps enough of the secondary defense back so that open running and line plunging has its real opportunity. Intentional infraction of the rules has almost entirely disappeared. The unsportsmanlike tactics that were creeping into the game are pretty much a thing of the past. Officials are enforcing the rules fairly, and their decisions are being accepted in a sportsmanlike way.

The reason the game is so popular today is not only that it is a great game and an interesting game, but that it is a clean game and played almost universally under high standards of sportsmanship. There is another reason. It is because it is an amateur game. Players are actuated not by financial reward but by love of the sport and sentiment for the college. It is sport for sport's sake.

More than any other nation in the world, we are a nation of sportsmen with especial interest in the outdoor sports. It is one of this country's greatest heritages. All the lessons of sport if it is played in the proper spirit are all to the good and tend to make better citizens. A poor sport in business is despised as heartily as the poor sport on the athletic field.

Of course, only twenty-two men can participate at the same time in a given football game, but thousands upon thousands can watch them in action, and I have no hesitation in saying that a crowd that has watched a cleanly played and hotly contested game between two college teams leaves the grounds having themselves absorbed something of the fine spirit of sportsmanship in which the game has been played. The influence of good, clean sport is good not only upon the people who participate but the interested audiences that are looking on.

Large Gate Receipts

But we are told that the game is too popular, that too many people attend the games, and that the gate receipts run into enormous figures. I have little sympathy for this criticism of today's game. What harm if the gate receipts are large? They are contributed in small amounts, and I see no harm in the aggregate being large provided it is put to proper uses. If there is any temptation to put any part of it to improper uses this can quickly be remedied by the academic and athletic authorities by giving full publicity to the accounts.

As a matter of fact, generally speaking, the gate receipts of football throughout the country are being put to one of the finest possible uses. Football is supporting to a greater or lesser degree practically all of the so-called minor sports which do not attract the crowds because they are not the wonderful team games that football is. What better possible use could be made of the money than using its excess receipts in the support of basketball, swimming, soccer, baseball, hockey, tennis, cross country running, track and field athletics, so that each and every one of these games is open to every member of the college without any tax or special burden upon him?

Over-Emphasis of the Game

We are saying a good deal lately about the over-emphasis of the game. Apparently this expression does not mean the same to all people. As I understand it, this means that perhaps the game has gotten out of its relative importance in the general scheme of college life and college interests; that too much time is devoted to playing it, watching it and discussing it. There may be and undoubtedly is in spots some justice for this criticism, but to my mind it is something that can be easily and simply remedied and in the natural course of events will tend to rectify itself.

There is some criticism that there is too much emphasis placed on winning and on winning all the games which a team plays. It may be that in spots the desirability of winning is greatly over-emphasized. The real thing is to have a team that deserves to win, and goes into each game determined to win if it is a possible thing. That's the sporting spirit, and with teams indifferent to whether they win or lose the sport would soon die out.

What we want if the sport is to be a real sport is to see teams using their utmost and maximum endeavors to win, taking their winning modestly and their defeats without complaint. And when I say winning, I mean, of course, winning by fair means.

When any team seeks to win by unfair tactics it harms the sport, and if general, would quickly destroy the game. Teams that over-emphasize the necessity of winning regardless of tactics employed and who on the field or in the recruiting of teams are guilty of unfair and unsportsmanlike actics are a menace to the game. The remedy is extremely simple. Eliminate them from the schedules of the colleges and schools that are trying to maintain the code, and let them come back when and only when they are willing to play the game according to the code.

I now wish to call attention to two conditions which have recently developed in connection with the game, and which, if not corrected, will in my judgment seriously tend to impair the present wholesomeness of the game and reflect upon its present high standing and good name.

Over-Emphasis of Individual Players

The first of these conditions is the tendency to very greatly over-emphasize, exaggerate and glorify the importance of individual players. This in my judgment is bad business, bad for the game and bad for the players. While I consider this a menace to the game which owes its virility and integrity in the last analysis to the fact that it is a team game and not a sport of individuals, fortunately it is being done largely by friends of the game. Accordingly, if they can be made to see, as I believe they can, that they are doing a real injury to the game by over-heroizing the individual players instead of promoting its best interests, the best remedy can be quickly and intelligently applied, and such menace as there may be eliminated or greatly minimized.

I hope I may not appear ungracious if, with the generous consent of my host, I give three illustrations of this tendency—all of which are, it seems to me, especially pertinent to discuss right now among the friends of football here present.

The first illustration is the practice of selecting mythical elevens in the form of all-American teams. First, let me say that no man over a long period of years has been more interested in watching for the naming of all-American teams than myself, and no one has read them or discussed them with greater interest.

Camp and All-American Teams

The all-American team is the creation of the brilliant friend and founder of American rugby football, our dear old friend, Walter Camp. He conceived the idea of a selection and publication of all-American teams for the purpose of creating more interest in football, a game which at the time was little known outside of half a dozen colleges. It undoubtedly helped to serve its purpose. Owing to the intelligent selection by Walter Camp after seeing most of the teams in operation, it came to be one of the traditions of the game. Walter Camp lived to see it help accomplish its purpose, and saw football reach a state of popularity which even he had never dreamed of.

Several times during the last two or three years of his life, he talked with me about the all-American teams and was several times on the point of abandoning them as the time had come when it was impossible to select a team with fairness to all players and that its original purpose had long since been accomplished. He, as a member of the Football Rules Committee, joined in voting to discontinue the publication of his own all-American team from the official football guides lest such publication seem to be construed as a recognition by the Rules Committee that there was any such thing as an official all-American team, or that the exploitation of the names selected was in the interests of football.

Tonight we are dining with one all-American team, and if there is any coach or newspaper which has up to the moment failed to select an all-American team of its own, it has not come to my attention. If everybody will continue to make up all-American teams perhaps there is no very great danger, but to the extent that ambition to be included in somebody's all-American selection supplants in a player's mind the desire to help the other players on his team win the game for his college, to that extent the influence of all-American teams is not a wholesome one.

Sports Reporters

And now I come to my good friends and the ardent friends of the game, the newspaper writers. Some of them, it seems to me, are unwittingly pretty bad offenders. When the beginning of the season comes around and once more they see a team or two in action the old sporting blood begins to run in their veins, and they feel the zip and dash and the clash of the conflict, they take a pen or typewriter in hand, and there is no limit except the limits prescribed by the encyclopedia and the rules of rhetoric.

Now, I have to admit that I like what they write so long as they talk about the *game*. They can compare it with the battles of Napoleon, the marches of the Crusaders, and they can put all the pomp and panoply and English into the story that it will hold, and I like it, and I suppose other people like it. But when they turn this exaggerated rhetoric loose on some innocent young lad who happened to run onto a bounding ball and run 45 yards to a touchdown and for the rest of the season keep comparing him with all the heroes of history, to the great detriment of said heroes, it is overdoing it and its influence is bad.

We don't want individual stars in football. We want teams of team players. Some of these will naturally stand out as exceptional, but lets not get it into their heads that that's the game. It's bad for them and it's bad for the game. If all the football writers generally should adopt this style, the time would come when we would forget that football was primarily a team game, and it would come to be considered by players and spectators alike as a game offering individuals an opportunity to star, and when that comes football will begin to decline.

When a football player goes onto the field to exhibit his personal prowess instead of to help his team to win, and the crowd comes to see a celebrity or two instead of a friendly contest between two rival football teams, it will be a sad day for bootball.

Criticism of Dinner

And now for the third illustration, and that illustration is this very dinner at which we are gathered. I ask you if a man ever allowed himself to perform a seemingly more ungracious act than to accept an invitation to this dinner, to accept our host's hospitality, to join in the entertainment and good time which we have all enjoyed, and then stand up here and say that I am unable to agree with my good friends of The Sun, all of whom I personally know to be staunch friends of the game, that an occasion of this kind is in the interests of football. Perhaps I am alone among all those in this room in holding this opinion, and I know to a certainty that you lads who have been so graciously brought in here to see each other and see New York City and hear all the fine things that have been said about you probably do not agree with me.

But I tell you, Oberlander, Grange, Tyron, and all the others, that I know a thought that has been continually running through your minds while you have been enjoying this trip and this occasion. And the thought is this. Wouldn't it be great if the rest of the eleven could come along and get in on this *peerade?* You fellows know and no one else realizes better than you that your fine accomplishment during the last season was made possible only by the loyal and unstinted support of your team-mates.

And you would be happier if you could share this good fortune with them and I will say very frankly to you lads that while I rejoice with every other follower of the game in the fine contribution you made this year on your team to the game and to its history, that the part you played is being entirely over-emphasized and while it may have been done with the best of motives it has done some injustice to your team-mates and injustice to players of other teams who could have probably made a record equally as good as your own if they had the same kind of support.

It has been a fine dinner, and an interesting and enjoyable evening, but I hope for the game's sake that it is the last time that any so-called all-American teams are called togther for an occasion of this kind.

PROFESSIONALISM

The second and last condition of which I wish to speak is the raiding of the college teams by the promoters of professional football teams, which has been invited and stimulated by this over-prominence given to individual college players.

First of all, let me make it very clear that I have no argument whatever with professional sport as such. I hope the time will never come when I shall cease to enjoy a good sparring match, a fast hockey game, whether amateur or professional and a baseball game in which either the Giants or the Yankees are one of the contenders.

Second, I would like to make it clear that although a staunch admirer of the college game of football. I have no fear that it will be supplanted by or will even be called upon to divide honors with professional football. The things that make college football a success canot be reproduced in professional football. They cannot be bought with money.

Third, I would like to make it very clear that I have no quarrel with the promoters of professional football if they limit their recruiting to non-college men; and

Fourth, I would like to make it clear that I thoroughly recognize that it is none of my business if any college man desires to enter professional football.

What I do object to, and what I believe is a menace to college football is the way some of the promoters of professional football are trying to lure the college player into the show-game against his own best interests.

PROMOTERS EXPLOIT REPUTATIONS

These promoters are seeking to exploit, capitalize and translate into cash for their own pockets the over-emphasis that the newspaper, the all-American pickers, we old grads and ex-players, the coaches, the undergraduates themselves and the public generally, have been placing on the individual performance of some of the outstanding players. In our enthusiasm over the game and our great joy at seeing it well played, we have made paper heroes of too many of the outstanding players.

We are a nation of hero-worshippers. First it's one hero, then another. Heroes don't last long. They don't even have to be real heroes. All they need to do is to be continually exploited and whether it's a movie artist, or some society woman with a record of eight divorces, the for-the-moment heavyweight champion, or the king home-run hitter, we want to look at him or her. It isn't hero-worship, its curiosity!

The professional promoters want to cash in on this and they realize that they must cash in quick. They offer the boys what every lad about to get out of college wants—a job—and with it they offer him big money and easy money. But it is not a real job, it is not a permanent job and it is not a good job. And it is not good money although it may be easy, and I will tell you why.

A boy goes to college to equip himself to earn a livelihood, and take his part in the affairs of the world. Professional football does not offer him the opportunity for either a livelihood or a life career, and in this respect differs very materially from professional baseball. No lad will last many years in professional football. He may be good for a year or two and then he has to start over fresh and he is just so much behind the others.

NOT A REAL LIVELIHOOD

The promoter who tries to lure the college lad into professional football knows that he is not offering him a livelihood or a real opportunity, but he offers him quick money and easy money and it looks good to the lad. Quick easy money is the worst thing that can be put into a lad's hands the first few years he gets out of college. He has got to learn sometime that he cannot earn his livelihood that way, and the year or two's experience with easy money in the atmosphere of professional sport is a bad start for any lad, and in my judgment not one in forty is big enough to be unaffected by it.

It is unfair to these boys after they have spent four years to fit themselves for some life job to have some promoter influence them to throw it all away in the pursuit of false gods.

And the pity of it all is that it is largely the friends of football who have so over-heroized and made celebrities of these youngsters, that they have developed the false idea in their minds which too often make it easy for them to accept the invitation to waste a few years in professional football.

We have a wonderful game, the greatest team game that the world has ever produced. It is a game richly worth preserving and friends of football should leave no word unsaid, no act undone, which will tend to preserve it in all its vigor, virility and wholesomeness for the boys of the coming generation.

Microscropic Training

To Keep Abreast with Latest Advancements in Geology, Colorado School of Mines Has Announced New Microscopic Courses

By W. A. Waldschmidt
Assistant Professor of Geology, Colorado School of Mines

BECAUSE of the increasing necessity of microscopic examinations in the investigation of geological and mineralogical problems related to oil field development, mining geology, and ore dressing, it has been necessary for schools to expand their courses involving the use of the microscope and to train more students of mining and geology in the fundamentals of the manipulation and use of the microscope.

In order to keep abreast with this advancement and to meet the requirements of contemplated changes in the required courses of study for petroleum geologists and mining geologists for the coming year, the Department of Geology of the Colorado School of Mines has equipped a laboratory for petrographic work only, and is now offering the following courses involving the use of the microscope:

W. A. Waldschmidt

Courses Offered

(1) *Optical Mineralogy,* a course which includes a brief review of the theory of light, the application of polarized light to the study of crystalline substances, the optical properties of minerals, and an introduction to petrography.

(2) *Petrography,* a course in which rocks are classified on the basis of their texture and mineral content. The latter is determined by a microscopic examination of thin sections or fragments.

(3) *Sedimentary Petrography,* a course particularly applicable to problems of sedimentation and oil field development. In this course instruction is given in the examination of sands, shales, and other sediments encountered in the drilling of oil wells; and in correlating sediments on the basis of microscopic fossils, sand grain size, percentage of heavy minerals in sands, porosity, and water analyses.

(4) *Mineralography,* a course in which the student is familiarized with the practical application of the metallographic microscope in the determination of ore minerals by reflected light. Special emphasis is given to the methods of preparing specimens for examination, and to the identification of the ore minerals, their association, alteration, and order of deposition.

(5) *Applied Mineralography and Petrography,* a course in which each student is required to examine a suite of ore and rock samples from a given mine or district and to submit a satisfactory report with special emphasis on the paragenesis of the ore minerals. This course requires investigation with both petrographic and metallographic microscopes.

Equipment Available

The equipment required in teaching these courses is fairly complete. At present it consists of twelve petrographic microscopes of various makes, a Euscope, used primarily for class room demonstration, two binocular microscopes, a complete set of index liquids, about 700 thin sections of rocks and minerals, and several necessary accessories. Through the courtesy of the Department of Metallurgy there are available for the examination of polished sections, twelve Bausch and Lomb metallographic microscopes, polishing machines, and one Leitz binocular microscope. Other equipment will be added to the petrographic laboratory from time to time as necessity requires.

The equipment mentioned above is used not only in teaching the courses described but also in assisting those graduate students and seniors who desire to do research in geology and mineralogy. Some of the problems now being investigated are the mineral changes in fused core drill samples, the paragenesis of the ore minerals of Cobalt, Ontario, the shell structure of the species Inoceramus Sowerby, and problems connected with several individual mineral species.

Fellowships Offered

The Colorado School of Mines is offering a number of fellowships in mining, metallurgy, geology, petroleum and chemistry. These are open to university graduates of the proper qualifications.

EXPLOSIVES IN 1925

A total of 58,380,217 pounds of permissible explosives was consumed in the United States in 1925, according to preliminary reports made by manufacturers to the Bureau of Mines, Department of Commerce. Final reports will probably show an increase of 6 per cent in sales of permissible explosives in 1925 as compared with 1924. Ninety per cent of the total amount sold in 1925 was for use in coal-mining operations. During the entire year the consumption of permissible explosives at bituminous coal mines averaged 77 pounds out of 325 pounds, or 24 per cent, of all kinds of explosives per thousand tons of coal produced. In anthracite mining the consumption of all kinds of explosives averaged 702 pounds per thousand tons of coal mined, and of this amount 195 pounds, or 28 per cent, were permissibles. Permissible explosives include ammonium nitrate explosives, hydrated explosives, organic nitrate explosives, and certain nitroglycerin explosives containing an excess of free water or carbon. All permissible explosives have passed certain tests of the Bureau of Mines designed to determine their safety for use in gaseous and dusty coal mines.

Sales of black blasting powder during 1025 are reported to the Bureau as being approximately 6,307,184 kegs of 25 pounds each. The amount of black powder sold in 1925 represents a decrease of 6 per cent in comparison with 1924. Of the total reported sales of black powder during 1925 coal mines used 84 per cent, metal mines 2 per cent, quarries and non-metallic mineral mines 4 per cent, railway and other construction work 6 per cent, and miscellaneous purposes 4 per cent. The consumption of blasting powder in bituminous coal mines in 1925 averaged 230 pounds out of 325 pounds of all classes of explosives per thousand tons of coal produced. At anthracite mines the consumption of explosives per thousand tons of coal during the year averaged 702 pounds, of which 203 pounds, or 29 per cent, were black powder.

During the year 1925 the total sales of other high explosives amounted to approximately 285,295,097 pounds. As compared with 1924 the amount sold in 1925 represents an increase of 4 per cent. Of the total amount used, 10 per cent was for coal mining, 33 per cent for metal mining, 26 per cent for quarrying and non-metallic mineral mining, 15 per cent for railway and other construction work, and 16 per cent for all other purposes. The quantity used at bituminous coal mines during the year 1925 averaged 18 pounds of high explosives out of 325 pounds of all types of explosives consumed per thousand tons of coal produced during the year. At anthracite mines the average was 304 pounds of high explosives out of 702 pounds of all classes of explosives per thousand tons of coal.

In 1925 mills manufacturing black powder were operated at approximately 38 per cent of their capacity as contrasted with operations on a basis of 41 per cent of capacity in 1924. In 1925 mills manufacturing permissibles and other high explosives operated at the rate of 2 per cent of capacity, which is the same rate as prevailed in 1924.

The Department of Agriculture, through the Bureau of Public Roads, distributed during 1925 a total of 14,214,750 pounds of pyrotol in various states, to be used mainly for land clearing and for road construction.

TO INCREASE OIL RECOVERY

Discovery of a process for the almost complete recovery of the oil content of "worked out" wells, has been announced jointly by Dr. F. M. Van Tuyl, head of the department of geology, and Prof. R. C. Beckstrom, head of the department of petroleum engineering.

The process, in brief, is the injection of an alkali solution in the "worked out" sands of an oil field. The alkali cuts the oil from the sand allowing the oil to form globules, which rise to the surface, because of lower specific gravity.

At the present time, 20 per cent recovery from a well is considered good. The new process, its discoverers claim, will enable the operator to make 90 per cent recovery at a very small cost. Inasmuch as the alkali in most cases is used as a 1 per cent solution, the cost is very low, especially if common washing soda is used. The reagents used in a long series of experiments were many and varied, but satisfactory results were obtained with alkalies of weak acids. Various oils were used in the experiments, and results were uniformly successful, although concentrations varied with different petroleums.

In their experiments, holes were bored in blocks of Dakota sandstone. Into the cavity formed an iron pipe was cemented, and oil forced through the pipe into the sandstone under a pressure of 60 pounds until the rock was saturated. Solutions were then forced through the pipe into the rock and the oil recovery measured. They tried a large number and variety of solutes but the best results were obtained with sodium carbonate. A 1 per cent solution gave almost double the recovery of oil as when pure water was used. Their work is now being tested in the field.

Equipment Received for Petroleum Dept.

The Petroleum Engineering department has received much valuable equipment this year and the department is thus bettering its curriculum by supplying much practical instruction to go with theoretical work. A complete working and operating model of a Slater turnbuckle derrick, 13 feet high, has been assembled at Stratton Hall. Much other miscellaneous equipment has been received from prominent manufacturers. At the Experimental plant, a model refinery is now in operation.

ATTEND PETROLEUM CONVENTION

By Chas. M. Rath, '05

During the convention of the American Association of Petroleum Geologists held in Dallas, March 25-26-27, 1926, there were a large number of School of Mines graduates, members of the faculty, and ex-Mines men in attendance. At noon on Saturday, March 27, all of those who could be brought together attended a luncheon at the Baker Hotel. Those present elected the writer to preside as chairman of the meeting. During and after the luncheon the available time was taken up by having each man introduced himself, state the year of graduation and his present occupation and business connections. Several short talks were made by some of the graduates, and especially noticeable was a short talk by Ronald K. De Ford, describing the present conditions of the school from the viewpoint of a recent graduate. This was followed by a somewhat longer talk by Professor F. M. Van Tuyl, head of the department of geology, who described the present condition of the school and the curriculum from the viewpoint of a faculty member. Following this Max Ball spoke more at length about the general condition and outlook of the school from the viewpoint of a member of the Board of Trustees.

There were in attendance graduates from as far back as 1902 and the list included some of the most recent graduates and also two of the distinguished men who have received honorary degrees by the school, namely W. Van der Gracht, and E. De Golyer.

Three papers were presented by Professors Beckstrom and Van Tuyl. The titles were, "Effect of Flooding Oil Sands with Alkaline Solutions," "Further Notes on the Effect of Compaction of Petroliferous Sediments," and "Notes on the Origin of Oil."

A paper which caused considerable comment was given by Tom Harrison, who graduated from Mines in 1908. The subject was the "Salt Domes of Utah." John H. Wilson, '23, presented a paper entitled, "Lithologic Character of Shales as an Index of Degree of Metamorphism."

Dr. E. de Golyer, Hon. '25, was succeeded by A. W. McCoy as president of the A. A. P. G. McCoy is vice president of the Marland Oil Company of Colorado.

Appended is a list of the names of those who were in attendance. In addition to this list should be mentioned Mr. Albert G. Wolf, class of 1907, who was in attendance at the convention until Friday night but was unable to attend the luncheon meeting Saturday noon.

Charles M. Rath, '05, Lynn W. Storm, '02, E. De Golyer, '25, F. W. Dakin, '23, R. C. Beckstrom, faculty, R. K. De Ford, '21, Thomas Allan, '18, G. F. Kaufman, '21, H. G. Schneider, '18, Wallace Lee, '04, M. H. Smirnoff, '24, K. L. Kithil, ex- , F. C. Seeley, '17, F. E. Heatley, '15, John H. Wilson, '23, R. S. Powell, '21, John R. Evans, '23, C. H. Stewart, '25, Kenneth S. Ferguson, '17, Harold W. C. Prommel, ex- , Max W. Ball, '06, W. Van der Gracht, '25, H. L. Baldwin, ex-'20, T. B. Romine, '19, Raymond C. Carr, '19, F. M. Van Tuyl, faculty, Thomas S. Harrison, '08, Hugh A. Stewart, '12, Cary P. Butcher, '24.

SCHOOL RECEIVES STAMP MILL RELICS

MR. MERCER of the South American Development Co. recently presented the school with some relics of early mining in Ecuador. An old andesite die, and three shoes from one of the early Spanish stamp mills comprise the collection now on exhibition in Dean Grant's office.

An interesting account of these installations is found in an old number of the Engineering and Mining Journal, written by F. W. Oldfield, which we quote in part here.

"These stamp mills consisted of separate batteries, each containing two stamps, and put up without a nail or a bolt. The shoes and dies were of stone, chosen from the hard, waterworn andesite boulders on the river banks. The shoes were squared and tapered at the shank, and fitted into a hole scooped out at the end of the stem. The die was a rock, large enough to receive both stamps, and kept in psoition by wedging with smaller rocks.

Since these dies had an oval surface, it was necessary to dress them, in order to start the direction of wearing. The dressing was done by a very hard rock, also a waterworn pebble, and called a 'cuna," the Spanish word for moil or wedge. The stem was a rougly squared timber, slotted for the reception of a protruding arm to act as a tappet, and working between guides of wood. The cams consisted of four arms, bolted radially onto a cam shaft, octagonal in section, which in its turn was fitted at either end with a hard wood bolt, running into a hard wood open box; the lubrication of this was a simple matter, it being done by a continual dropping of water conveyed by a bamboo pole, hollowed out in the middle. The mortar consisted of housing for the twin die, the screen being a piece of board with nine holes placed in front of the die. The fineness of crushing was entirely controlled by height of discharge, this latter being regulated by taking out or putting in plugs in the holes in the screen.

"The motive power of the batteries was supplied by water, turning an overshot wheel. The only requisite of a millsite was the proximity of a mountain stream, and the remains of these mills are frequently to be found in the shape of old shoes and dies.

"The pulp leaving the batteries flowed through a canal 12 feet long and 15 inches wide fitted with rough blankets in 3-foot strips. The head blankets were taken out and washed in a box at intervals of about 15 minutes depending upon the grade of the ore. The remaining blankets were washed as required. This canal discharged into a hole capable of holding a ton or so. Here the tailings were caught they of course were returned to the batteries, and if too fine were thrown away. More blankets were placed in the tail race beyond the holes. The gold and concentrate caught on the blankets were then amalgamated with mercury in a wooden 'batea.' The life of the shoes and dies was about 25 days; each battery crushed from 400 to 600 pounds per 24 hours, according to the hardness of the rock."

FACULTY IS NAMED

ONLY two resignations of faculty members were accepted at the April meeting of the Board of Trustees. Donald Mullen, '25, instructor in metallurgy, has resigned to enter the practical field and Lawrence Hampton, instructor in mathematics resigned to continue his work for a higher degree. Forty members of the old faculty are retained in the list published here, issued by Dr. Coolbaugh. The list follows:

Lester S. Grant, dean and professor of mining.
Thomas M. Bains, Jr., associate professor of mining.
C. F. Barb, instructor in petroleum engineering.
R. A. Baxter, assistant professor of chemistry
R. C. Beckstrom, professor of petroleum engineering.
A. E. Bellis, professor of physics.
F. C. Bond, instructor in chemistry.
E. F. Bruhn, assistant professor of civil engineering.
C. B. Carpenter, associate professor of metallurgy.
R. E. Cuthbertson, laboratory assistant experimental plant.
J. R. Everett, associate professor of mathematics.
H. W. Gardner, professor of civil engineering.
W. P. Huleatt, assistant professor of geology.
E. B. Jacobs, instructor in chemistry and physical training.
Joseph S. Jaffa, professor of mining law.
J. H. Johnson, associate professor of geology.
D. C. Johnston, director of athletics.
M. C. Kiess, instructor in geology.
E. L. Lewis, professor of economics.
A. P. Little, professor of electrical engineering.
Earl P. Martinson, assistant professor in mathematics.
W. L. Maxson, associate professor of metallurgy.
J. R. Morgan, field secretary and professor of Spanish.
J. L. Morse, professor of mechanical engineering.
Roscoe W. Morton, instructor in mechanical engineering.
W. V. Norris, associate professor of chemistry.
J. F. O'Byrne, professor of descriptive geometry.
I. A. Palmer, professor of metallurgy.
Earl H. Peterson, assistant professor in English.
W. J. Risley, professor of mathematics.
L. D. Roberts, associate professor of chemistry.
G. W. Salzer, assistant professor of descriptive geometry.
P. F. Shannon, professor of petroleum engineering.
H. E. Short, assistant professor of physics.
James Underhill, associate professor of mining.
F. M. Van Tuyl, professor of geology.
W. A. Waldschmidt, assistant professor of geology.
S. Power Warren, associate director of experimental plant and associate professor of metallurgy.
A. J. Weinig, director of experimental plant.
R. B. Eldredge, chemist, experimental plant.

REUNION FOR 1901 CLASS

TWENTY-FIVE years ago, 37 seniors of the Colorado School of Mines started out to buck the world as alumni of the class of 1901. A great change has come over the men in the quarter-century. The scope of this change and a thousand other points of interest will be discussed by those members of the class who come back to Golden for the reunion on Commencement Day, May 21. George B. Clark of Denver is sponsoring the reunion movement and through his efforts, the plans are materializing.

The known addresses of members of 1901, Colorado School of Mines, are as follows:

Bradley, Joseph M., R. R. 2, Box 92, Arvada, Colo.
Brinker, Arthur C., Engineer Gold Mines, Ltd., Atlin, Alaska.
Bruce, J. L., Cyprus Mines Corp., Skouriotissa, Nicosla Cyprus.
Bumstead, Edward J., 505 Chapman Bldg., Los Angeles, Cal.
Collins, Shrive B., Wagon Wheel Gap, Colo.
De Cou, Ralph E., 709 Forest Ave., Tempe, Ariz.
Downer, Roger H., Goldfield, Nev.
Ehle, Mark, Jr., University of Arizona, Tucson, Ariz.
Jackson, Walter H., Dixis Brick & Tile Co., Puryear, Tenn.
Lewis, Frank E., Chisas Mining Co., Terlingua, Texas.
Lovering, Ira G., Box 1133, Dawson, N. M.
Millard, Frank W., Ely, Nev.
Parrish, Karl C., General Const. Co., Box 6, Barranquilla, Columbia, S. A.
Pray, Winifred A., Fernley, Nev.
Scheble, Max C., Box 1140, San Antonio, Texas.
Street, Gerald B., 8064 Du Pont Bldg., Wilmington, Del.

Living in Denver, Colo.

Bowman, Frank C., 2060 Dahlia St.
Burlingame, Walter E., 1915 Lawrence St.
Clark, Geo. B., 456 Railway Exchange Bldg.
Johnson, Junius W., 1035 Lafayette St.
Marrs, Geo. O., 1570 Detroit St.
McDaniel, Alex K., 700 Franklin St.
Simpson, Wm. P., 1744 Broadway.

Addresses Unknown

Breed, Chas. F.
Sale, Andrew J.
Starbird, Ed P. (incapacitated).

Deceased

Atwater, Maxwell W.
Bishop, Raymond.
Chandler, John W.
Crow, Wade L.
Frank, Harry L.
Harris, Willard F.
Ducy, Frank A.
May, John G.
Small, Harvey B.
Watson, Hugh.
Williams, Fred T.

DEAN KETCHUM IS SPEAKER

MILO Smith Ketchum, dean of the college of engineering at the University of Illinois, will deliver the principal address at the Colorado School of Mines Commencement exercises at Golden, May 21.

Dean Ketchum, who was dean of the University of Colorado engineering college for fifteen years, is one of the outstanding engineers of the United States. His publications are accepted as standards in structural and civil engineering and his educational ability is recognized all over the world.

He is a graduate of the University of Illinois with degrees of B.S. and C.E., and taught at his Alma Mater for a number of years after graduation. He spent a number of years in the practice of structural engineering before coming to the University of Colorado in 1904 as professor of civil engineering. The following year he was made dean of the engineering college and held both positions until 1919, when he accepted a similar post at the University of Pennsylvania.

He accepted the position of dean of the engineering college and director of the engineering experiment station at the University of Illinois in 1922 and has been connected with Illinois in this capacity ever since.

Dean Ketchum belongs to many honor societies. He was president of the American Society for the Promotion of Engineering Education in 1918 and was president of Tau Beta Pi, honorary engineering fraternity, in 1920. He also belongs to Sigma Xi, the American Society of Civil Engineers and A. A. A. S.

NOW FOR SOME ATHLETES

BLUE KEY, a national college organization, is represented at Golden by Vigilantes chapter, a group of men who dedicate the chapter to betterment of Mines athletics, scholarship and spirit. Every available athlete will be dragged to Golden if the men have any influence and steps will be taken to keep them at Mines for good. Alumni will be asked to help in this great task that the students are handling themselves for the present. They will start bombarding with letters right away.

NEWS NOTES

Pulverized Coal Hazards

A complete discussion on explosion hazards from the use of pulverized coal at industrial plants is contained in Bulletin 242, Department of Commerce, just issued.

Colorado's Ore Reserves

Colorado's probable ore reserve amounts to 10,000,000 tons, a five-year supply at the present rate of consumption, Charles W. Henderson, engineer in charge of mineral resources for the United States Bureau of Mines, told members of the Colorado Scientific Society.

Probable ore, Mr. Henderson pointed out, is the kind that 'is likely eventually to be mined," but is not blocked out. "Estimates of the quantity of ores beyond a period of five years are extremely hazardous," declared Mr. Henderson. "A much clearer prophecy can be made at the end of the present year and in the light of developments now in the projected stage."

Carson Finally Wins Fight

George Campbell Carson's claim to improvements and refinements in the side charging of reverbertory furnaces have been upheld by the United States Circuit Court and the American Smelting and Refining Co., the company sued by Carson for patent infringements, has been ordered to pay the desert wanderer a considerable sum of money.

Utilization of Peat

Bulletin 253, Department of Commerce, "Possibilities for the Commercial Utilization of Peat," has just been issued. It was written by W. W. Odell and O. P. Hood.

Analysis of Missouri Coals

This is the title of Technical Paper 366, recently issued by the Department of Commerce. The paper was written by W. T. Thom, Jr.

Federal Oil Conservation Board

The complete record of public hearings of the Federal Oil Conservation Board has been issued in pamphlet form by the Department of Interior. Copies are 25 cents.

French Debt Settlement

Charles Piez, president of the Illinois Manufacturers' association, and chairman of the board of the Link-Belt Co., recently outlined a method for settling the French debt to the United States. This pamphlet is available at the Link-Belt Co. office and the letters between Piez and Senator Borah on the subject are printed in full.

Treatise on Sedimentation

This imposing volume of 650 pages, just released by Williams and Wilkins of Baltimore, is the most comprehensive treatise on sedimentation ever published. The author, William H. Twenhofel, is head of the department of geology at the University of Wisconsin. His collaborators include the foremost sedimentationists in the United States and it is interesting to note that Dr. F. M. Van Tuyl of Golden is a contributor. That sedimentation is far more complex than originally believed is shown by the following statement in the introduction:

> "The study of sedimentary rocks has not kept pace with that of igneous rocks, and courses in petrography have mostly been courses in the petrography of igneous rocks. The general inability to observe the igneous rocks in process of formation appears to have lent enchantment to their study, while the sedimentary rocks, forming almost at the petrographer's door and almost everywhere about his home, received scant consideration, and in many instances were not noticed. The processes of sedimentary rock formation were considered simple. It appeared obvious that sands ultimately resulted in sandstone, muds in clay and shale, and shells in limestone. It is now beginning to be appreciated that this conception of the simplicity of sediments and sedimentary rocks is a mistake and that a given sedimentary rock is the end product of a long series of complex processes."

An excellent book for the geologist and for those engineers interested in the fascinating history of the earth.

Oil Shale

The February number of the *Wisconsin Engineer* has an article by Robert A. Baxter, '23, assistant professor of chemistry at Colorado Schol of Mines, entitled "Probable Future of the Utilization of Oil Shale." Baxter treats oil shale in a different manner than most writers and expresses the opinion that low carbonization of shales will be past the experimental stage in eight years.

Denver Rock Drills

Bulletin No. 150, describing the entire line of Waugh products for contracting, quarrying, mining, etc., has been issued by the Denver Rock Drill Co., of Denver, Colo. Two new products are announced, Model 7 Drifting Drill and Model 15 Concrete Breaker. Bulletins will be furnished on request.

History of Colorado Mining

A history of discovery, development and production of Colorado mining has recently been published by the Department of the Interior. The complete volume has been written by C. W. Henderson. Copies are $1.00 and worth it.

Discovery Depletion

A discussion of the history, economic base and justification of discovery depletion in relation to the mining industry, has recently been issued in pamphlet form by the general tax committee of the American Mining Congress, Munsey Bldg., Washington, D. C.

CAMPUS BRIEFS

Presidents Organize—The Colorado Association of State Institutions of Higher Learning was formed at Boulder recently at a meeting of the presidents of the six state-supported institutions. The purpose of the organization is for discussion of problems that are common to the state institutions and to secure greater cooperation, the elimination of misunderstandings by a frank discussion of problems and aims of the member institutions. As a step toward economy the first act of the new association was to authorize the formation of an association of the purchasing agents of the state institutions. Ideas and experiences will be exchanged by the purchasing agents, a common policy will be formed and efforts made to effect greater efficiency and greater economies. Dr. Charles A. Lory of the Colorado State Agricultural College, Fort Collins, was elected president. Others present were Dr. George W. Frasier, president of the State Teachers; Dr. Ira Richardson, president of Adams State Normal, Alamosa; Dr. Samuel Quigley, president of Western State Normal, Gunnison; Dr. Melvin F. Coolbaugh, president of Colorado School of Mines, and Dr. George Norlin, president of the University of Colorado.

New Math Instructor—Guerdon D. Nichols of the University of Nebraska has been appointed instructor in mathematics for next year. Mr. Nichols took his undergraduate work in Iowa State College, University of Wisconsin, and University of Iowa, receiving the B. A. degree from the last named school in 1924. During his college career he specialized in mathematics and physics and did thesis work in these subjects. His work as an instructor at Nebraska University has been very satisfactory, and he comes well recommended by the professors under whom he has studied. Mr. Nichols is married and has two children.

R. O. T. C. Reviewed—The Mines R. O. T. C. unit will be recommended for distinguished rating next year if the embryo soldiers improve as much in 1926-1927 as they did in 1925-1926, Col. C. R. Mayo, R. O. T. C. officer for the 8th Corps Area announced early in the month after inspecting the local battalion. Capt. Hutchings and Capt. Cole, assisted by Staff Sergeants Meagher and Weigman, showed a snappy inspection that was worth seeing. The reviewing officer could not but be pleased with the showing of the Miners.

Mine Rescue Courses—Practical instruction in mine rescue and first aid work was given recently by U. S. Bureau of Mines Car No. 2 at Golden. Under actual mining conditions, the men were given demonstrations in the use of oxygen breathing apparatus at the old tunnel near Mt. Zion. The men were required to do heavy timbering while wearing the apparatus in order to be thoroughly familiar with this type of work. The car was in charge of V. C. Murray.

Lectures Enjoyed—The lectures given under the joint auspices of the American Gas Association and Sigma Gamma Epsilon at Mines this spring, were enjoyed and attended by hundreds of students and members of the faculty. The talk on "Low Temperature Carbonization of Coal" by Dr. Arno Fieldner, chief chemist of the Bureau of Mines, was the feature of the series and will be printed in an early issue of the Magazine.

Mines Radio Night—Colorado School of Mines had the ether on April 21 from 8 until 10 P. M. An all-Mines recital was given by talented persons of the school and many alumni report good reception.

Trips Completed—The annual inspection trips to mines, smelters, mills, structures and refineries of the Rocky Mountain region, were completed early in the month. The mining trip visited plants in Colorado and Utah; the geologists went by automobile to New Mexico and southern points of Colorado, while the petroleum engineers visited fields and structures in the vicinity of Houston, Texas. All trips were very successful.

Ceramics Course—Sensing the need of men skilled and trained in ceramics, an elementary course has been introduced at the School. Prof. Huleatt, '21, is instructing the class and plans to enlarge the new course next year. The proximity of the Golden clay deposits makes the school ideally located for this class of work. The state of Colorado harbors a number of important clay deposits and it is fitting that its mining school should attempt to develop the industry.

Robinson Cup Awarded—Beta Theta Pi, with a group standing of 82.16 wins the Robinson scholastic cup for 1926, T. C. Doolittle has announced, after checking the grades of all students and organizations in an elaborate survey. The cup will be awarded Commencement Day. Many interesting statistics in connection with Doolittle's scholastic survey will be printed in next month's Magazine.

Band at Cheyenne—The Colorado School of Mines band, under the direction of Prof. A. E. Bellis, gave a concert in the high school auditorium at Cheyenne, Wyo., last Saturday. The concert was given under the auspices of the Cheyenne High School R. O. T. C. The concert was well received by a large audience, and the band was given a real welcome at the capital.

Class Ring Designed—A beautifully designed gold ring for graduates of the school has been ordered by the senior class. It is proposed that succeeding classes adopt the same ring.

PERSONAL NOTES

Frank D. Aller, '92, has changed his address from Durango, Colo., to Leadville, Colo., where he receives mail at Box 867.

Phil M. Collins, '93, died Jan. 12, 1926, at Miami, Oklahoma, according to information supplied by *Horace Atkins, '94.* Phil had been an invalid for the past six years but had kept up his courage and had great hopes of recovering until shortly before the last severe illness. He had many friends among the alumni who will be grieved to hear of his passing.

Horace H. Atkins, '94, local manager of the Prairie Oil and Gas Co., at Muskogee, Oklahoma, has written an interesting letter to the office this month. In addition to informing us of the death of *Phil Collins, '93,* he writes that he enjoys the Magazine immensely but would like to have more news about his former classmates.

Arthur Roller, '97, consulting engineer in Denver, is accompanying his daughter to California where she will be married soon to James Grace. He will probably visit Col. Ball on a consolation, rather than consultation visit.

N. W. Logue, '97, is chief engineer for the American Smelting & Refining Co., at Hayden, Arizona.

William D. Waltman, '99, is making an extensive trip in Europe.

C. C. Malmstrom, '99, assayer at the Denver mint, was a recent Golden visitor.

C. J. Adami, '99, expects to tour Europe this summer, accompanied by Mrs. Adami and Charles, Jr., who graduates in June from Princeton after taking a course in business administration.

Louis R. Ball, '00, feels a trifle older if we are to judge from Los Angeles reports announcing the engagement of his daughter, Miss Dorothy, to Richard Shaler of South Pasadena, Calif. Col. Ball is a consulting engineer at South Pasadena and may be addressed at 1204 Pine St.

Harry F. Bruce, '00, may be addressed at Tonopah, Nevada.

Jacob Weil, '04, owner of the Weil Tobacco Co., Quincy, Florida, passed away last January, according to word received at the alumni office recently. Particulars are unavailable at this writing. His many friends express their sympathy to surviving relatives.

Irving B. Williams, '11, is now with the United States Bureau of Mines at Bartlesville, Oklahoma.

Walter C. Huntington, '12, has accepted a position with Stearns-Roger Co. of Denver. He recently returned from Mogollon, Mexico. His present address is 3121 Lowell Boulevard, Denver.

Donald Dyrenforth, '12, recently returned from a business trip to New York for the Dorr Co. His new home address is 2635 Bellaire St., Denver.

S. P. Warren, '13, associate director of the Experimental Plant, recently returned from an extended trip to Alaska and several of the Western mining states.

C. Erb Wuensch, '14, is now addressed in care of A. J. McAllister, 100 Broadway, New York City. He has been in Mexico with Compania de Real Del Monte Y Pachuca at Hidalgo.

Frederick Foote, '14, is superintendent of the Gossan Mines of the General Chemical Co., at Monarat, Virginia. He may also be addressed at 40 Rector St., New York City.

H. W. Kaanta, '15, has changed his address from Santa Barbara, Mexico to San Francisco del Ore Mines, Ltd., San Francisco del Oro, Chih., Mexico.

Charles Vorck, '16, is with the Internal Revenue Service with offices at the State Capitol building, Denver.

C. L. Bocke, '20, is with Capitan Blanco No. 1, Parral, Chih., Mexico.

Frederick Brinker, '21, will be married soon to Miss Natalie Tyler, daughter of Justin R. C. Tyler, of Durango. Their engagement was announced recently. Miss Tyler, who is active socially in Denver, is a graduate of Denver University. Fred is employed as research chemist with the Metals Exploration Co., at Durango, Colo.

Ronald K. DeFord, '21, of the Midwest Refining Co. geological staff, has returned to Denver after doing field work at Abiline, Texas.

Gus Neumann, '21, is with Nevada Consolidated at Ruth.

Arthur K. Seeman, '22, is with the Thriftway Laundry, 984 East 35th St., Brooklyn, New York.

Louie C. Rhodes, '22, is now located at 120 Howard St., Hibbing, Minn. This information was kindly furnished by George Koenig, secretary of the Masonic lodge at Golden.

C. Frank Jordan, '23, is with the A. S. & R. Co., at Santa Barbara, Chih., Mexico, having resigned as shift boss at Jerome with the United Verde. He is now foreman at the Tecolotes mine.

John Yates, '23, is teaching mathematics and Descriptive Geometry at Washington University, St. Louis, Mo.

William Gray, '23, is assistant superintendent of the United States Zinc Co.'s smelter at Amarillo, Texas.

John Denny, '23, has resigned his position at Cripple Creek and is now at Washington, D. C., with his family.

Arthur D. Swift, '23, has moved from Miami to Tampa, Florida.

Fred Kirby, '23, is office manager for the Goodman Mfg. Co., at Charleston, West Virginia.

Robert Edwards, '23, was a recent visitor at the alumni office. He is located in Denver and lives at 125 East 11th Ave.

Phil Mahood, '24, who is with the Bethlehem Steel Co., is now at Steelton, Penna., designing switches, guard rails and similar equipment. He is addressed at 327 Walnut St.

H. H. Wright, '24, is at Wasgo, Calif., engaged in diamond drilling for the Marland Oil Co. of California.

Clement Lehnertz, '24, is with the St. Joe Lead Co., engineering department at Bonne Terre, Mo.

Henry J. Hersey, Jr., '24, is with Tonopah Belmont at Tonopah, Nevada. He writes to Dean Grant that *John Mann, '24,* is at Grass Valley with North Star Eng. Co., *Fred Figel, ex-'24,* is at Comstock and *Allison Fishwild, '23,* is at Bisbee.

Max Bowen, '24, has resigned his position as research engineer for the American Cynamid Co., at Golden and is now with the Portland at Victor, Colo.

Morris K. Barrett, '24, is with the Marland Oil Co., at San Angelo, Texas.

C. D. Frobes, '24, contributed an article on electric firing underground to the St. Joe Lead Co. safety magazine, for March.

(Continued on Page 18)

MADE DEPARTMENT HEAD

J. R. MORGAN, field secretary and professor of modern languages at the Colorado School of Mines for the past three years, has been named head of the department of languages and economics for the coming year, following a consolidation of the modern languages and economics and English departments, it was announced today.

PROF. J. R. MORGAN

Dr. E. T. Lewis, professor of economics for the past year, is retained in that capacity, and Earl Peterson, assistant professor of English, will have the same position in the reorganization. It is probable that an instructor in modern languages will be appointed before the fall term opens.

Professor Morgan is well known in Colorado educational circles. For ten years he was superintendent of schools at Trinidad, Colo. He recently was named director of the Mines Summer Session for 1926.

BASE BALL SEASON STARTS

WITH plenty of inclement weather to keep the ball tossers from practicing, the Miners made a rather inauspicious opening of the baseball season, losing the first game to Regis, 10-2 and dropping the next contest to Denver University at Golden, 12-2. However, the men made a comeback in the third game, winning from Denver University 5 to 4 at the Pioneer's field.

Del Rio pitched all three games. It appears that his arm has now loosened up and that he will turn in a number of victories in 1926. The team on the whole is green, but there is the consolation that the rookies are improving rapidly and that they will amount to something before the season is over.

The Regis games do not count in the conference standings.

Regis College 10—Mines 2

With most of the veterans away on the Junior trip, the Miners lost the first game of the season to Regis at Denver, 10-2. Del Rio pitched good ball, but his support was poor, the Oredigger clan making many errors while Regis went errorless.

Simmons, freshman, played well at shortstop except in the sixth inning when he made two errors. Regis scored five runs in this inning. Palrang pitched seven innings for Regis and struck out ten men and walked nine. In the second, Sotock and Gallagher got on bases by walks and Rice knocked a three-bagger through center field, bringing them in for Mines' two scores. Rice showed up exceptionally well in center field. He made the only two hits for Mines and his fielding was perfect. He is practically certain of a position on the varsity with playing like this. Gallagher, catcher; Del Rio, pitcher, and Sotock, second baseman, were the only lettermen in this game. Gallagher played his first game at catcher position and looks fine.

Denver University 12—Mines 2

Although the Pioneers, with their great array of veterans, defeated the green Dynamiters at Golden in the second game of the season, the Orediggers showed a vast improvment over the Regis game which indicated a better team in the next contest. In the next game, the following week, the Miners turned the tables on Denver.

Denver literally swamped Mines under an avalanche of batting. Del Rio yielded fifteen hits but was given ragged support. Simmons, newcomer at third base, showed lots of class and Jenkins on first, played well for a rookie. O'Connor at short and Sotock at second looked good. Rice is a new fielder who covers lots of ground and Volk fits in well at right garden. Wells and Regan tried left field for this game.

Bob Boyd of Denver, as usual, slammed out a homer—his usual stunt on Brooks Field. Howell pitched a fine game for Denver.

To Receive Degrees in Person—President Coolbaugh has notified all seniors that all men receiving degrees in 1926 must be present at Commencement exercises, May 21. Men accepting positions must have their employers understand that they will not be available Commencement day.

PERSONAL NOTES

(Continued from Page 17)

John E. Griffith, ex-'25, is superintendent of the Fall River Mining Co. property at Idaho Springs, Colo.

Donald Davis, '25, was married April 24 to Miss Lillian Viola Harvey of Washington, D. C. Davis was a prominent member of the M. E. T. fraternity and is now located at 1335 Columbia Road, N. W., Washington.

Frank Delahunty, '25, is employed in the open hearth department of the Inland Steel Co., at Indiana Harbor, Ind. His address is 3813 Fir St.

Ward Graham, '26, star football player, was married recently to Miss Verna Graves of Golden, at the Golden Presbyterian Manse. Rev. A. J. Dressler performed the ceremony. Graham comes from Forest, Oregon, and came to Golden after attending Civic University there. He is a member of Mu Epsilon Tau and Theta Tau and was considered the best football player on the squad last fall. The couple are living at Bonanza, Colo., where Ward has a position in one of the mines.

Claude Booth, ex-'26, was married early in April to Miss Maurine Smith of Anaheim, Calif. Booth made his home in Nebraska before coming to Mines and is now employed at the west portal of the Moffat tunnel.

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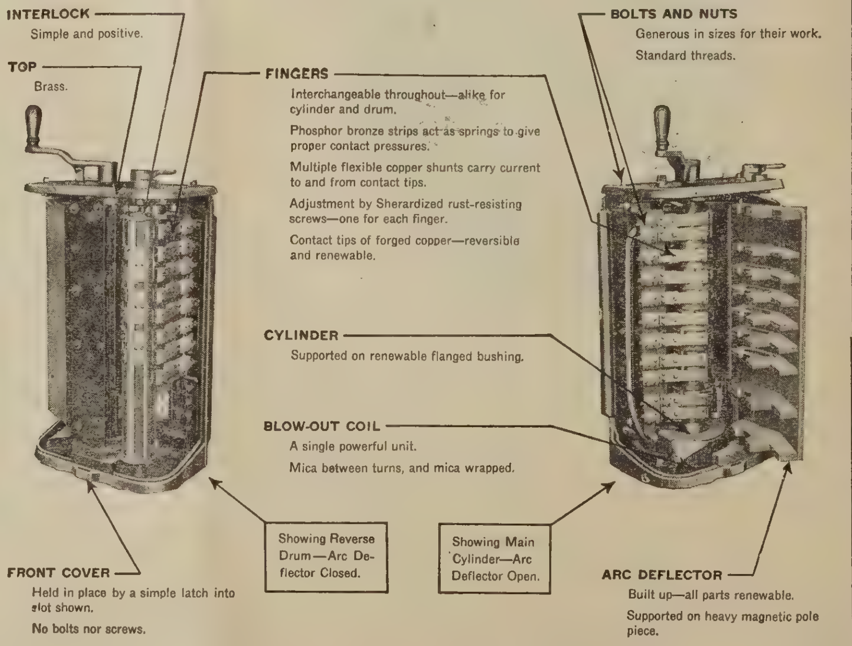
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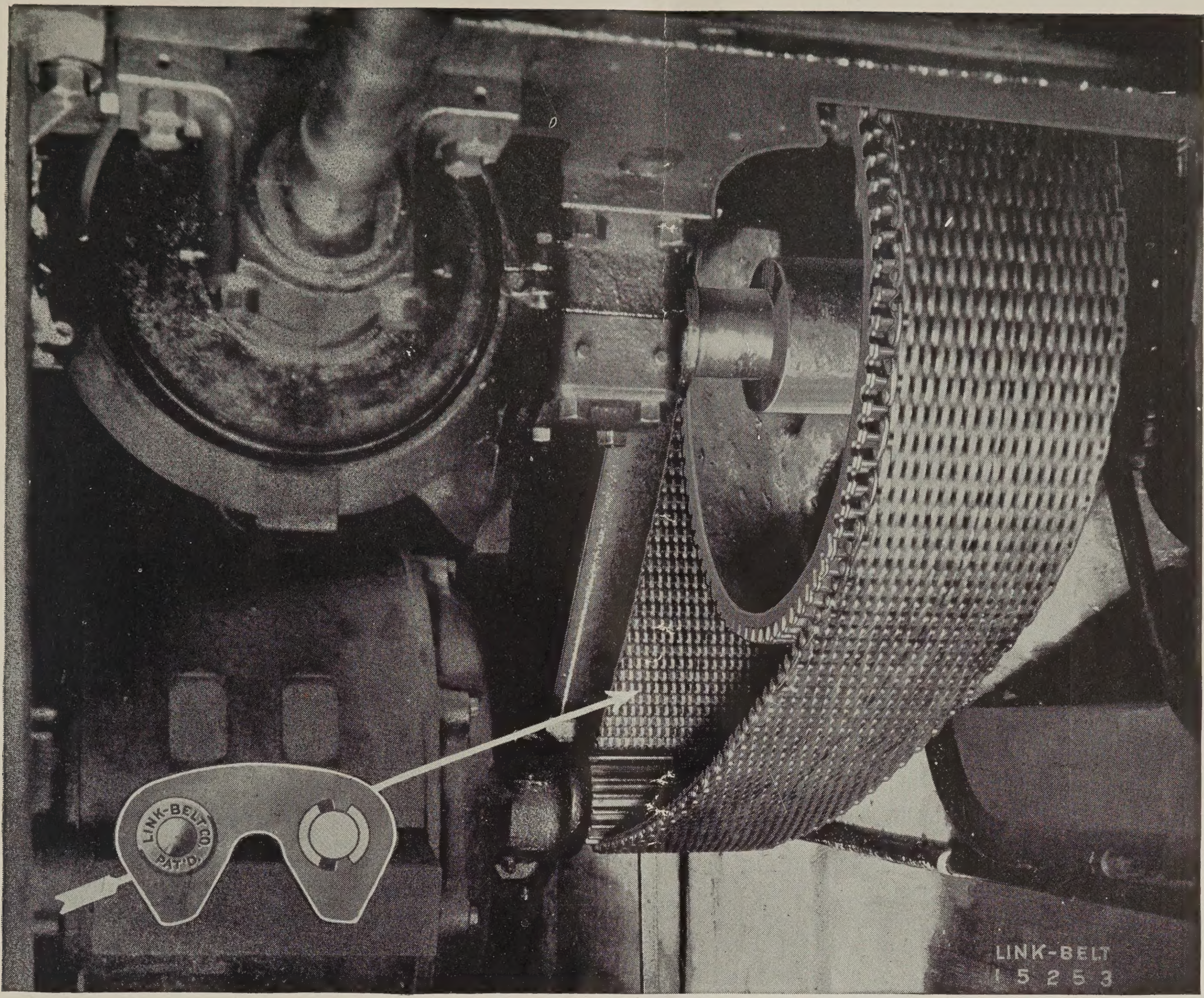

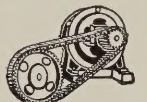

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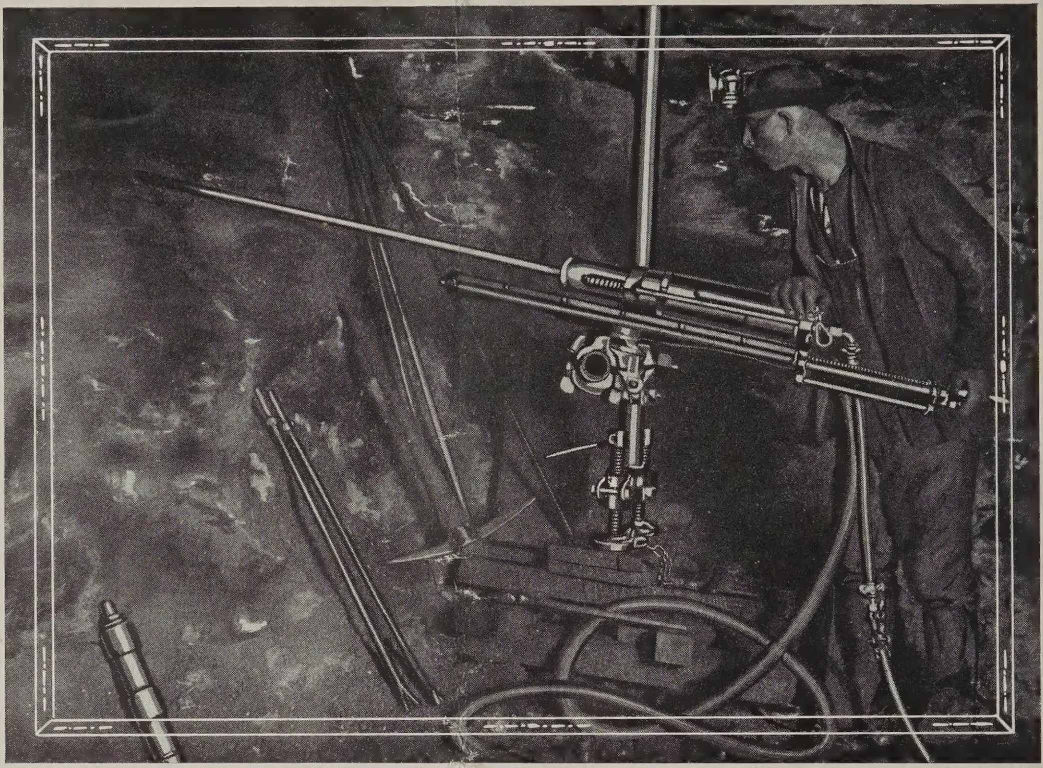

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